

TECHNICAL BULLETIN

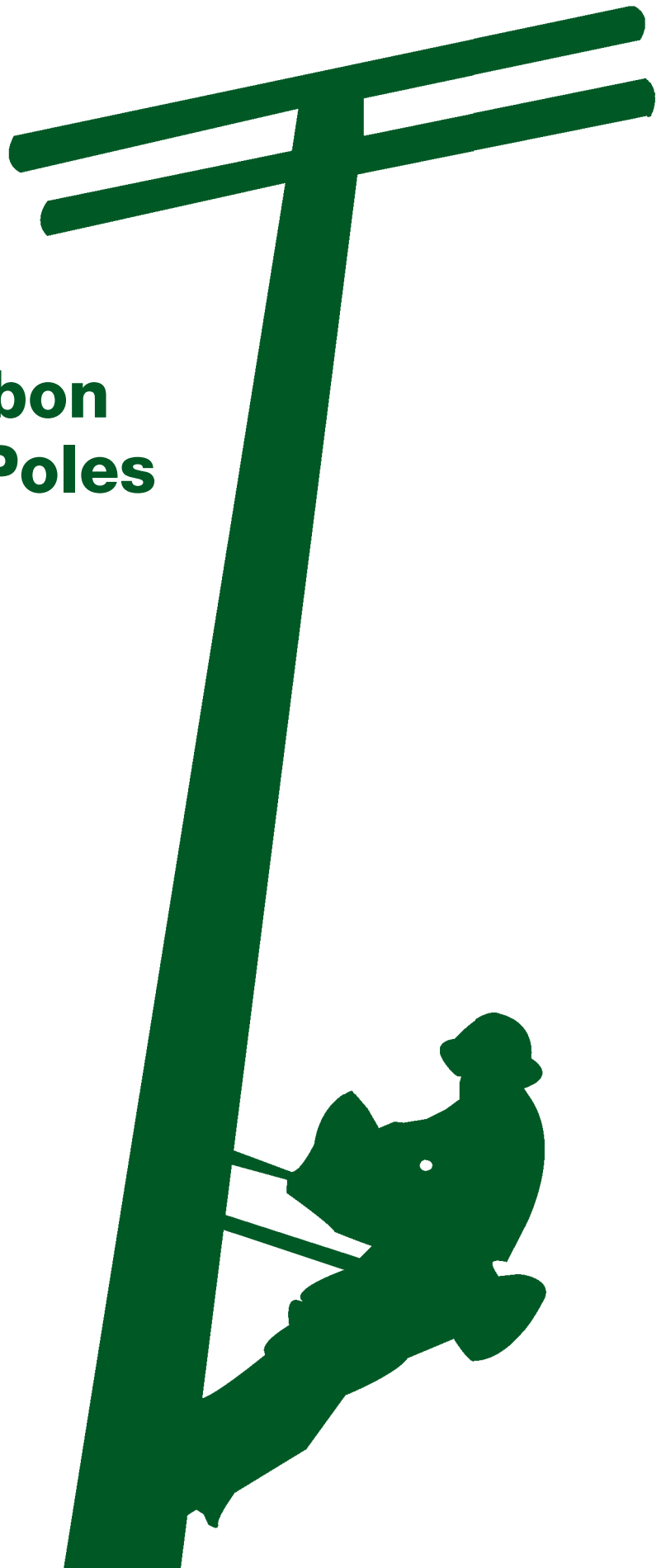
Calculating Carbon in Wood Utility Poles and Crossarms

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About NAWPC

The North American Wood Pole Council (NAWPC) is a federation of three organizations representing the wood preserving industry in the U.S. and Canada. These organizations provide a variety of services to support the use of preservative-treated wood poles to carry power and communications to consumers.

The three organizations are:

Western Wood Preservers Institute

With headquarters in Vancouver, Wash., WWPI is a non-profit trade association founded in 1947. WWPI serves the interests of the preserved wood industry in the 17 western states, Alberta, British Columbia and Mexico so that renewable resources exposed to the elements can maintain favorable use in aquatic, building, commercial and utility applications. WWPI works with federal, state and local agencies, as well as designers, contractors, utilities and other users over the entire preserved wood life cycle, ensuring that these products are used in a safe, responsible and environmentally friendly manner.

Southern Pressure Treaters' Association

SPTA was chartered in New Orleans in 1954 and its members supply vital wood components for America's infrastructure. These include pressure treated wood poles and wood crossarms, and pressure treated timber piles, which continue to be the mainstay of foundation systems for manufacturing plants, airports, commercial buildings, processing facilities, homes, piers, wharfs, bulkheads or simple boat docks. The membership of SPTA is composed of producers of industrial treated wood products, suppliers of AWPA-approved industrial preservatives and preservative components, distributors, engineers, manufacturers, academia, inspection agencies and producers of untreated wood products.

Wood Preservation Canada

WPC is the industry association that represents the treated wood industry in Canada. WPC operates under Federal Charter and serves as a forum for those concerned with all phases of the pressure treated wood industry, including research, production, handling, use and the environment. WPC is dedicated to promoting and supporting a stronger Canadian wood treating industry; informing the public on the benefits to be gained from the use of quality wood products; and preserving the integrity of the environment through the promotion of responsible stewardship of our resources.

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Introduction

Utility companies have been striving to reduce the amount of carbon dioxide (CO₂) emissions associated with their operations, particularly related to energy generation. To do so, they have been replacing coal and natural gas combustion (both fossil fuels) with renewable energy sources, particularly wind and solar.

A factor often overlooked by utilities is that they sequester carbon in their inventory of wood utility poles and crossarms.

Wood is the only building material that is carbon positive, meaning that its manufacture and use results in a reduction of CO₂ in the environment.

Wood is “manufactured” in forests as trees grow by the process of photosynthesis in which CO₂ is removed from the air and converted into wood and free oxygen using water and solar energy. When used for long-lasting utility poles and crossarms, the carbon in the wood is stored for many decades, typically 70 or more years.

Such long-term storage is called sequestration. The sequestered carbon is not CO₂ in the air that is contributing to climate change.

While this wood is providing service, more wood is growing in the forests and removing CO₂ from the atmosphere.

The amount of carbon that is sequestered in a utility’s inventory of wood utility poles and crossarms can be calculated. This calculation takes into account of the volume and mass of the wood, as well as the mass of carbon dioxide removed from the atmosphere while the wood is in service within overhead structures.

Determining carbon sequestration

The **Utility Wood Pole & Crossarm Carbon Calculator** is a simple Excel spreadsheet developed to assist utility providers in calculating the amount



of carbon sequestered and carbon dioxide (CO₂) removed from the atmosphere for wood poles and crossarms.

These carbon amounts can be determined when a utility enters information from their inventory of wood utility poles and crossarms.

Calculations are made utilizing the most common or representative pole class/length groups and the actual dimensions of the most common or representative wood crossarms used by a utility.

Once entered, the **Carbon Calculator** estimates the volume of wood, mass of wood, stored carbon in the wood and mass of carbon dioxide removed by using wood poles and crossarms.

Note that carbon dioxide is calculated in metric tonnes (1,000 kilograms or 2,200 pounds) because that is the unit of measure accepted both in the U.S. and internationally.



Wood Utility Pole & Crossarm Carbon Calculator

Utility Name: _____
 Form Completed By: _____
 Date: _____

Wood Poles Calculation

| Pole Group | Pole Class | Pole Length | No. of Poles | Volume (ft ³) | MCF Total |
|------------------|------------|-------------|-------------------|---------------------------|--------------------|
| 1 | 4 | 45 | 130,000,000 | 25.6 | 3,328,000 |
| 2 | H-3 | | | | |
| 3 | H-2 | | | | |
| 4 | H-1 | | | | |
| 5 | 1 | | | | |
| 6 | 2 | | | | |
| 7 | 3 | | | | |
| 8 | 4 | | | | |
| 9 | 5 | | | | |
| 29 | | | | | |
| 30 | | | | | |
| Totals for Poles | | | 130,000,000 poles | | 3,328,000 MCF wood |

Select Pole Class and Length by pull down. Enter the number of poles.

Note: MCF is 1,000 cubic feet

Wood Crossarm Calculation

| Size Group | Thickness (inch) | Width (inch) | Length (feet) | No. of Crossarms | Volume (ft ³) | MCF Total |
|----------------------|------------------|--------------|---------------|-----------------------|---------------------------|-----------------|
| 1 | 3.0 | 7.5 | 6.0 | 100,000,000 | 0.94 | 93,750 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |
| Totals for crossarms | | | | 100,000,000 crossarms | | 93,750 MCF wood |

Enter actual dimensions of crossarms in digital equivalents (1/2 in. = 0.5 in.)

Note: MCF is 1,000 cubic feet

Carbon Sequestration Calculation and Summary

| | | |
|---|------------|---------------------------|
| Total Volume of Wood in Poles and Crossarms | 3,421,750 | MCF wood |
| Mass of Wood | 54,234,738 | tons of wood |
| Mass of Carbon | 27,117,369 | tons of carbon |
| Mass of Carbon (metric) | 24,652,153 | tonnes of C |
| Mass of Carbon Dioxide (metric) | 90,391,229 | tonnes of CO ₂ |

Entering pole inventory

In **Carbon Calculator**, the number of utility poles are entered by major classes and lengths. Classes and lengths are standardized by ANSI to provide equal load capacity, independent of wood pole species.

The pole classes and length are from the American Wood Protection Association (AWPA) **Book of Standards** Tables 4 and 5¹.

Wood is typically approximately 50% carbon, on a dry weight basis². Wood from Southern Pine timber is approximately 31.7 pounds per cubic feet dry weight density³.

For the purpose of these calculations, Southern Pine density is assumed for all wood. Any differences with Douglas fir poles are accounted for by the slightly larger sizes as defined in the ANSI standards. Thus, assuming all poles have the same density introduces no significant error.

Crossarm volumes are calculated from the actual dimensions. Use the decimal equivalents when entering dimensions (i.e. 1/2 inch = 0.5 inch).

Calculation example

As an example, approximate U.S. totals can be entered as sample entries in the **Carbon Calculator**. There are an estimated 130 million wood utility poles in service⁴ in the U.S. For this example, assume the poles are Class 4, 45-foot poles.

In the **Carbon Calculator**, select 4 from the pull-down menu for Pole Class. For the Length, select 45 from the pull-down menu. In the No. of Poles blank, enter 130,000,000. The cubic feet of wood in each pole will be calculated at 25.6 cubic feet.

For crossarms, a conservative estimate of 100 million (100,000,000) are used in the U.S. A typical crossarm measures 3.0-inches by 7.5-inches and is 6.0-feet in length. Enter these dimensions where indicated in the **Wood Crossarm Calculation** section.

Based on these entries, the 130 million wood utility poles contain 3.328 million MCF, or thousand cubic feet, of wood. The 100 million wood crossarms contain 93,750 MCF of wood.

¹ AWPA, 2020. Book of Standards. Website www.awpa.com

² Ragland, Aerts, and Baker. Properties of Wood for Combustion Analysis. Bioresource Technology, 0960-8524/91/S03.50. 1991.pgs 161-168.

³ Bolin, C. and Smith, S. 2011. Life cycle assessment of pentachlorophenol-treated utility poles with comparison to steel and concrete utility poles. Renewable and Sustainable Energy Reviews, 15, 2475-2486.

⁴ Roewer (2008): Comments on Pentachlorophenol Revised Risk Assessments: Notice of Availability and Solicitation on Risk Reduction Options – Docket ID No. EPA-HQ-OPP-2004-0402. Letter to USEPA from Utility Solid Waste Activities Group (USWAG). June 16, 2008

Carbon sequestration calculations

Once the wood pole and crossarm data are entered, totals for the volume and mass of wood and the carbon sequestered are calculated automatically in a **Summary Report** at the bottom of the sheet.

For the example of the inventory of wood utility poles and crossarms estimated in use within the U.S., the total is 3.4 million MCF (thousand cubic feet) of wood with a mass of 54 million tons.

This wood is estimated to contain 27 million tons of carbon (25 million metric tonnes of carbon). It represents approximately 90 million metric tonnes of CO₂ removed from the environment and stored in the wood poles and crossarms while in use.

Summary

This amount of CO₂ removed from the environment with the use of wood poles and crossarms can be put into perspective by comparing it to the U.S. total electric energy related CO₂ emissions.

According to the U.S. Energy Information Administration, in 2018 American utilities accounted for 1,770 million metric tonnes⁵ of CO₂ emitted into the environment through generation of electrical power.

Thus, the sequestered CO₂ in U.S. utility poles and crossarms represent approximately 5% of U.S. electricity generation-related annual emissions.

The Environmental Protection Administration (EPA) provides an online **Greenhouse Gas Equivalencies Calculator**⁶ that can assess the amount of carbon sequestered in wood poles and crossarms.

For example, the amount of carbon in 2,000 H-1 poles, 60 feet in length is 990 metric tonnes. That is equal to the amount of greenhouse gas emissions generated from driving 9 million miles in an average passenger automobile.

The CO₂ removed from the environment by these poles represents the emissions from some 408,462 gallons of gasoline consumed.

Downloading the calculator

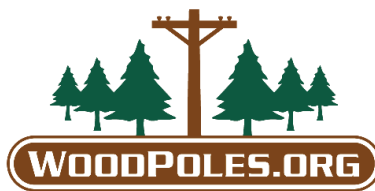
The **Utility Wood Pole & Crossarm Carbon Calculator** Excel spreadsheet is available for downloading at www.woodpoles.org. Users can enter the pole and crossarm data for the utility and generate a report listing the volume of carbon sequestered and carbon dioxide removed from the environment because the wood is in service.

This information can assist a utility in communicating its commitment to the environment using scientifically derived information.

⁵ U.S. Energy Information Administration. U. S. Energy-Related Carbon Dioxide Emissions, 2018. Website <https://www.eia.gov/environment/emissions/carbon/>

⁶ U.S. Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator, March 2020. Website <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

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North American Wood Pole Council