



Summary Report
End-of-Life Management of Preserved Wood
The Case for Reuse for Energy
November 2010

Wood products are treated with wood preservatives to extend their service lives in weather-exposed or wet environments, or in environments subject to microbial and insect attack. Preservatives allow products that would otherwise fail within months or years to last from decades to nearly a century. A preserved wood product's service life continues until the product, or the structure in which it is a part, must be replaced. Outdoor decking may have a service life from five¹ to 30 years, utility poles from 15² to nearly 100 years, and railroad ties from 10³ to 60 years. Service life depends on factors including the exposure environment, applied loads, product quality, maintenance, and user preferences. Most carbon in the preserved wood product is stored at least until the end of its service life. Following primary service, some preserved wood products can be reused in less demanding applications, such as poles being used for fencing, thereby further extending their service lives. Eventually all preserved wood products must be removed. End-of-life management options for those removed preserved wood products generally include abandonment at use sites, disposal in non-hazardous landfills, or reuse as an energy source.

Wood preservatives are approved for use by the United States Environmental Protection Agency (EPA). The EPA has allowed end users of such products to make end-of-life management decisions for preserved wood products without hazardous waste restrictions. The end-of-life disposition option chosen has environmental implications, and environmental improvement opportunities are available through the proper management of preserved wood at the end of life. This paper summarizes the energy and greenhouse gas (GHG) ramifications of end-of-life management options⁴.

The cradle-to-grave life cycle of preserved wood products is similar to other wood products and agricultural products. Seeds sprout and grow using photosynthesis to extract carbon dioxide (CO₂) from the atmosphere to create hydrocarbon mass; the mature tree is harvested and converted through manufacturing processes into useful products, which serve their desired function; and then end-of-life disposition options result in some of the embodied carbon being returned to the atmosphere and some being sequestered in long-term (hundreds of years) storage. Instead of "ashes to ashes," the cycle is CO₂ to CO₂.

¹ Typically a result of home improvements that result in deck removal and not due to product failure.

² Typically a result of road widening projects and not product failure.

³ Typically a result of track realignment and not product failure.

⁴ Complete evaluation by Smith, S.T. and Bolin, C.A. 2010 entitled End of Life Management of Treated Wood is available on the WWPI website at www.wwpinstitute.org.

On average, dry wood mass is approximately 48% carbon. Each cubic foot of wood contains approximately 15 pounds of carbon representing 55 pounds of carbon dioxide removed from the atmosphere.

Estimated annual preserved wood production in the U.S. is approximately 640,000 Mcf (1Mcf = 1,000 cubic feet)⁵. Annual production volumes by preservative type are estimated to be 87,000 Mcf for creosote, 32,000 Mcf for oil-borne treatments, and 520,000 Mcf for water-borne treatment. In addition, approximately 2,400 Mcf of lumber and plywood is protected with fire retardant⁶.

According to USEPA’s AP-42, Compilation of Air Pollutant Emission Factors, wood has a fuel value of approximately 9,000 BTU per pound of dry (zero moisture content) wood mass. The effective heat value is reduced by the amount of water in the wood since water must be evaporated and heated to exhaust gas temperature in a combustion process. Moisture content for wood is traditionally stated on a dry-wood basis, which is equal to the weight of water divided by the dry weight of wood. Green sapwood biomass typically contains approximately 100 percent moisture or more. At 100 percent (meaning one part water for each part dry wood mass), the contained heat is approximately 4,500 BTU per pound and the effective heat content (after heating and evaporating the water) of wood fuel is approximately 3,200 BTU per pound. Used preserved wood is typically drier than “green” wood. While it can vary greatly depending on its previous use and storage conditions, the moisture content is typically about 20 percent. Wood fuel at this moisture content has effective heat value of approximately 7,200 BTU per pound.

Based on AquAeTer’s representative model, including a mix of wood species, wood preservatives either have no impact or add to the heat value when used as fuel. The heat value of wood products typically preserved with water-borne and oil-borne preservatives is approximately 7,000 BTU/pound and for creosote preserved hardwood is approximately 8,000 BTU/pound. As part of the end-of-life management assessment, AquAeTer prepared a simplified cradle-to-grave life cycle inventory (LCI) to model end-of-life alternatives for preserved wood. The end-of-life scenarios are summarized in Table 1.

Table 1 - End-of-Life Scenarios

| End-of-life option | Common/Current Practice | Reuse for energy | Landfill disposal |
|-----------------------------------|-------------------------|------------------|-------------------|
| Scenario No. | 1 | 2 | 3 |
| Secondary use with decay in place | 10% | 10% | 10% |
| Reuse to energy | 20% | 90% | 0% |
| Landfill disposal | 70% | 0% | 90% |

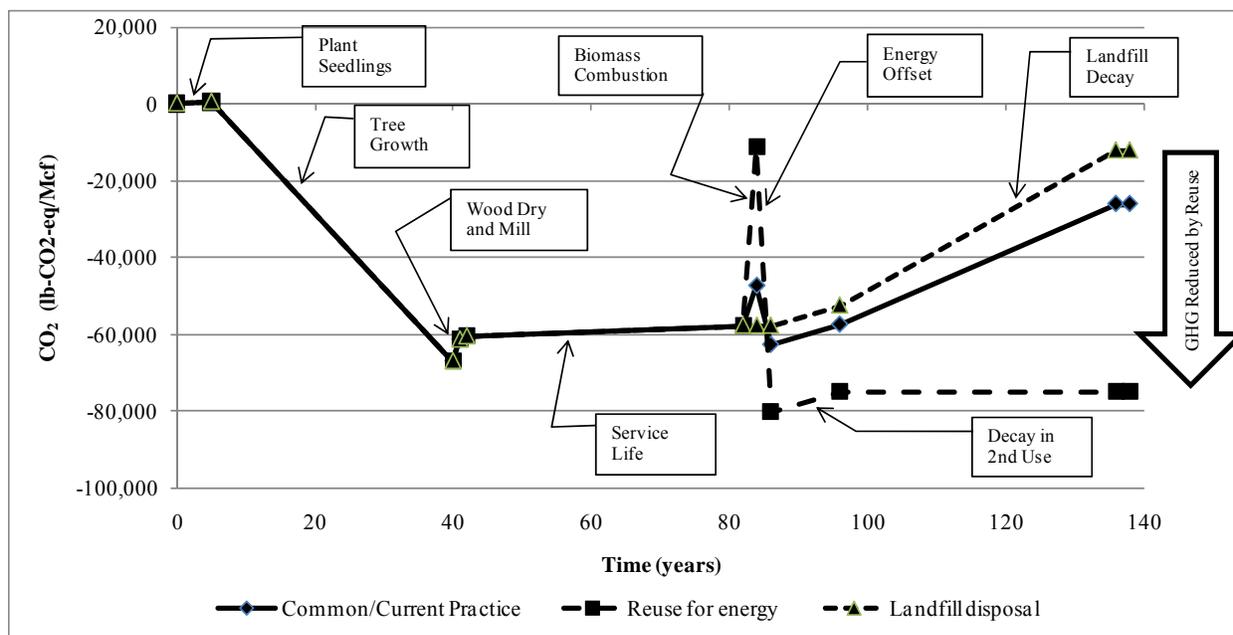
The total cradle-to-grave GHG balance, including contributions and credits from both fossil and biogenic sources is presented in Figure 1. The GHG balance is presented in units of pounds of

⁵ Smith, S.T., 2009. Economics of Treated Wood Used in Aquatic Environments. Chapter IV in Book “Managing Treated Wood in the Environment” J.J. Morrell, K. Brooks, T. LaDoux, and D. Hayward to be published by WWPI in 2010.

⁶ Vlosky, Richard P. 2009. Statistical Overview of the U.S. Wood Preserving Industry: 2007. February 16, 2009.

CO₂-equivalent per Mcf of preserved wood. Sawdust and other by-products from milling are used for energy, resulting in energy offsets. Following service life, each of the three disposition scenarios are tracked separately. The baseline represents approximately the average mix of disposition choices currently applied to the overall preserved wood market. The reuse and landfill options represent the possible extremes of choices with all preserved wood going to one or the other disposition options so that differences can be highlighted. The reduction in GHG emissions associated with reuse of preserved wood for energy amounts to approximately 70,000 pounds of CO₂-eq. per Mcf of preserved wood, compared to a reduction of approximately 10,000 pounds under the landfill scenario. The difference between the two options is highlighted by the arrow on the right side of Figure 1.

Figure 1 - Total (Biogenic and Fossil) GHG Balance for Preserved Wood



All scenarios result in reduction, rather than increase, of GHG over the life cycle of a preserved wood product. GHG accounting includes offset credits for the beneficial use of by-product bark and sawdust for process heat and energy production. The energy credits are equal and opposite to an equal heat value that would have been needed from non-renewable fossil fuel use (e.g., use of biomass fuel in a boiler instead of natural gas use).

Preservative chemicals (in preserved wood) combusted with biomass fuel need not result in higher or more hazardous emissions in comparison to other fuels. The carbon-based preservatives, such as creosote and pentachlorophenol, are destroyed by combustion in appropriate combustion devices. Metals, such as copper, chromium, arsenic, and boron, are effectively controlled by appropriate combustion and control equipment and operating procedures. It is the appropriate matching of combustion conditions and equipment with the fuel being used that affects emissions.

The beneficial reuse of preserved wood products as a non-fossil source of energy, following primary service life, is currently underutilized. Although many preserved wood products are

being reused for energy, such as combustion systems, kiln fuel or gasification, significant increased market reuse of treated wood products is possible.

The energy contained in 640 million cubic feet (estimated annual production) of preserved wood is equivalent to approximately 32 million barrels of oil. If beneficially used, the energy would offset the fossil fuel use of approximately 646,000 U.S. citizens or about 0.21 percent of total U.S. fossil fuel use.

Since the CO₂ emissions from wood, a biogenic fuel, are neutral regarding GHG emission impacts, use of this fuel reduces GHG compared to use of equivalent amounts of fossil fuel. The offset to GHG associated with the full utilization of 640 million cubic feet of preserved wood is equal to the annual per capita GHG emissions of approximately 870,000 U.S. citizens or about 0.29 percent of the U.S. total GHG output.

The impact on U.S. landfill capacity is large. Disposal in landfills of 640 million cubic feet of preserved wood equates to approximately nine percent of annual U.S. landfill disposal volume.

Exploiting the end-of-life value of preserved wood would thus provide an expanded energy source while lowering GHG emissions and reducing landfill requirements. Federal, State, and regional governments and agencies should encourage and reward beneficial reuse of preserved wood following removal from service. Recommended actions toward this end include:

- Include preserved wood that has been removed from service within the definition of “biomass” in any laws or regulations. Any incentives used to encourage use of renewable biomass at approved or permitted facilities should apply equally to preserved wood biomass.
- Repeal laws that prevent or ban the use of preserved wood for energy.
- Do not pass laws that would regulate preserved wood removed from service.