# Conclusions and Summary Report on an Environmental Life Cycle Assessment of ACQ-Treated Lumber Decking with Comparisons to Wood Plastic Composite Decking

## ISO 14044 Compliant

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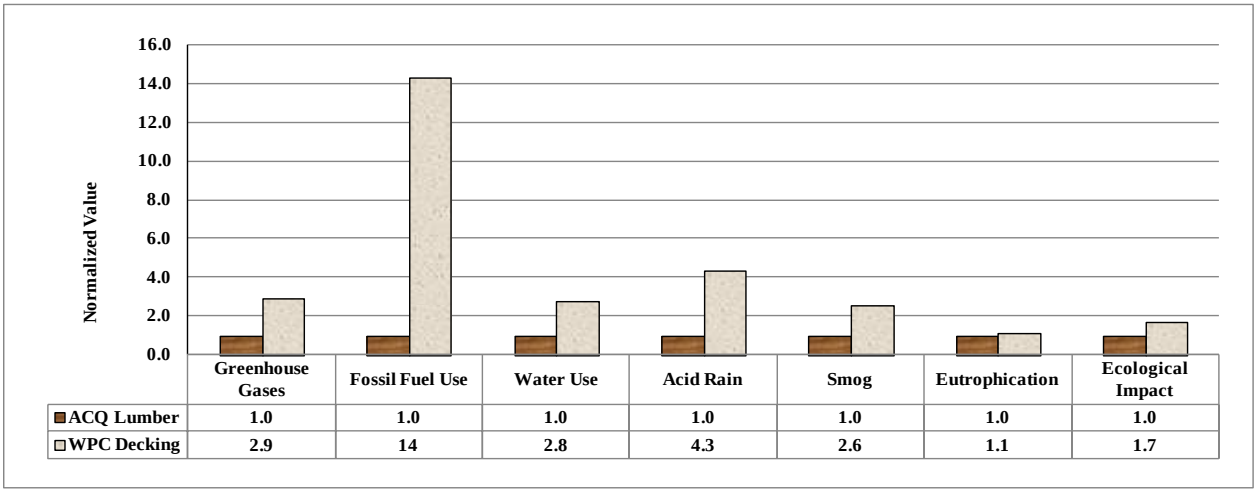
# Conclusions and Summary Report

## 1. Conclusions & Executive Summary

The Treated Wood Council has completed a quantitative evaluation of the environmental impacts associated with the national production, use, and disposition of ACQ (alkaline copper quaternary)-treated lumber decking and wood plastic composite decking using life cycle assessment (LCA) methodologies and following ISO 14044 standards. The results for treated wood decking are significant.

- **Less Energy & Resource Use:** Treated wood decking requires less total energy, less fossil fuel, and less water than wood plastic composite decking.
- **Lower Environmental Impacts:** Treated wood decking has lower environmental impacts in comparison to wood plastic composite decking in all five of the impact indicator categories assessed: anthropogenic greenhouse gas, acid rain, smog potential, ecotoxicity, and eutrophication-causing emissions.
- **Less Fossil Fuel Use:** The fossil fuel footprint of a treated wood deck is equivalent to driving a car 38 miles/year. In comparison, the fossil fuel footprint of a wood plastic composite deck is equivalent to driving a car 540 miles/year.
- **Recoverable Energy:** The carbon embodied in wood makes out-of-service wood products excellent candidates for energy recovery. Treated wood can be used in cogeneration facilities or synthetic fuel manufacturing facilities as a non-fossil fuel source.

**Figure 1 Impact indicator comparison (normalized to ACQ-treated lumber = 1.0)**




| | Greenhouse Gases | Fossil Fuel Use | Water Use | Acid Rain | Smog | Eutrophication | Ecological Impact |
|---|---|---|---|---|---|---|---|
| ACQ Lumber | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| WPC Decking | 2.9 | 14 | 2.8 | 4.3 | 2.6 | 1.1 | 1.7 |

Impact indicator values for the cradle-to-grave life cycle of ACQ-treated lumber were normalized to one (1.0), with wood plastic decking impact indicator values being a multiple of one (if larger) or a fraction of one (if smaller). The normalized results are provided in Figure 1.

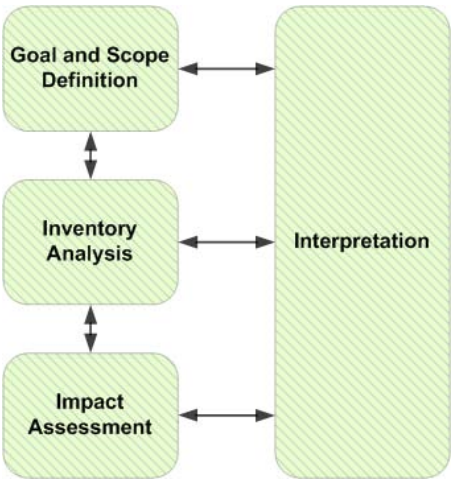
## 2. Goal and Scope

The goal of this study is to provide a comprehensive, scientifically-based, fair, and accurate understanding of environmental burdens associated with the manufacture, use, and disposition of decking materials using LCA methodologies. The scope of this study includes:

- A life cycle inventory of ACQ-treated lumber decking and wood plastic composite decking. ACQ was chosen as a representative preservative for assessment of treated wood decking.
- Calculation and comparison of life cycle impact assessment indicators: anthropogenic greenhouse gas, acid rain, smog, ecotoxicity, and waterborne eutrophication impacts potentially resulting from life cycle air emissions.
- Calculation of energy, fossil fuel, and water use.

## 3. Quality criteria

This LCA study was done in accordance with the principles and guidance provided by the International Organization for Standardization (ISO) in standards ISO/DIS 14040 and ISO/DIS 14044. The LCA procedures and findings were evaluated by a panel of external reviewers in accordance with Section 6 of ISO 14044. The external reviewers confirmed that the LCA followed the ISO standards and that the comparative assertions were done using equivalent functional units and equivalent methodological considerations.




## 4. Manufacturer Information

This assessment addresses two decking products.

- The LCA for ACQ-treated lumber decking includes weighted averages of survey responses representing 47% of the total U.S. ACQ-treated market.
- The LCA for wood plastic composite decking represents a general product category, manufactured with different designs and material contents. The LCA provides a basis for general comparison of products.

# 5. Product Description and Functional Unit

The products of focus in this LCA are (1) ACQ Type D-treated Southern pine nominal 1¼-inch thick lumber (also referred to as "radius-edge decking"), treated for above-ground, exterior exposure according to the AWPA standards, and (2) wood plastic composite decking.

Scope: Cradle-to-grave

Functional unit: one 320 square foot deck of surface decking material per year of use manufactured using 5/4 x 6 inch decking.

Service life: 10 years

System boundary: from the extraction of the raw materials through processing, transport, primary service life, and disposition of the product.

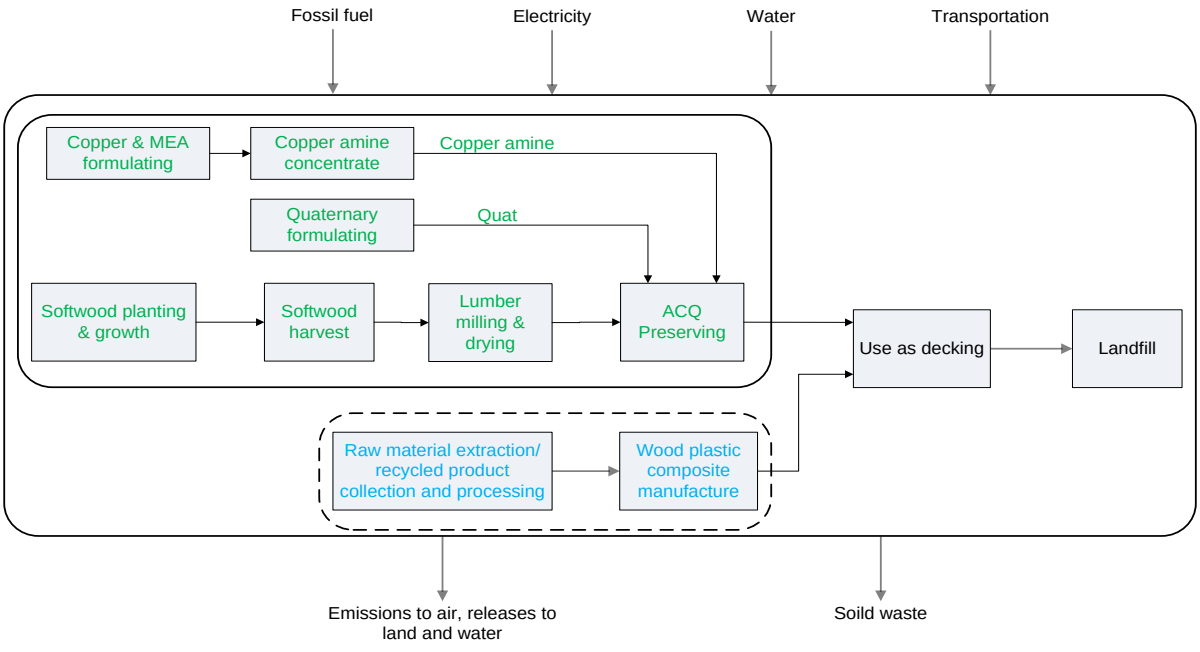
Geographic boundary: U.S.

# 6. Life Cycle Inventory

The inventory analysis phase of the LCA involves the collection and analysis of data for the cradle-to-grave life cycle of the deck surface material. For each stage of the product life cycle, inputs of energy and raw materials, outputs of products, co-products and waste, and environmental releases to air, water, and soil are determined.

The system boundaries include all the production steps from extraction of raw materials from the earth and manufacture of the decking product (cradle-to-gate) to use of the product and final disposition after its service life (cradle-to-grave). Figure 2 illustrates the system boundaries and process flow for both ACQ-treated lumber decking and wood plastic composite decking as assessed in this study.

**Figure 2 System boundary and process flow for decking (Cradle-to-gate processes for ACQ-treated are shown in green and wood plastic composite are shown in blue. Gate-to-grave processes are shown as the same.)**



A 10-year service life is used in this analysis for both ACQ-treated lumber decking and wood plastic composite decking, acknowledging that safe service life could be much longer, but that aesthetics and remodelling projects often prematurely result in deck replacement or removal. The ACQ-treated lumber decking inventory includes the inputs and outputs associated with one application of deck sealant.

ACQ-treated lumber decking and wood plastic composite decking are compared, based on 320 square feet of decking (16 by 20 feet), a typical size deck for a U.S. family.

## 7. Environmental Performance

The assessment phase of the LCA uses the inventory results to calculate total energy use, impact indicators of interest, and resource use. For environmental indicators, USEPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) is used to assess anthropogenic greenhouse gas, acid rain, smog potential, ecotoxicity, and eutrophication impacts potentially resulting from air emissions. The categorized energy use, resource use, and impact indicators provide general, but quantifiable, indications of environmental performance. The results of this impact assessment are used for comparison of ACQ-treated lumber decking and wood plastic composite decking as shown in Table 1.

**Table 1 Environmental performance (per representative deck per year of use)**

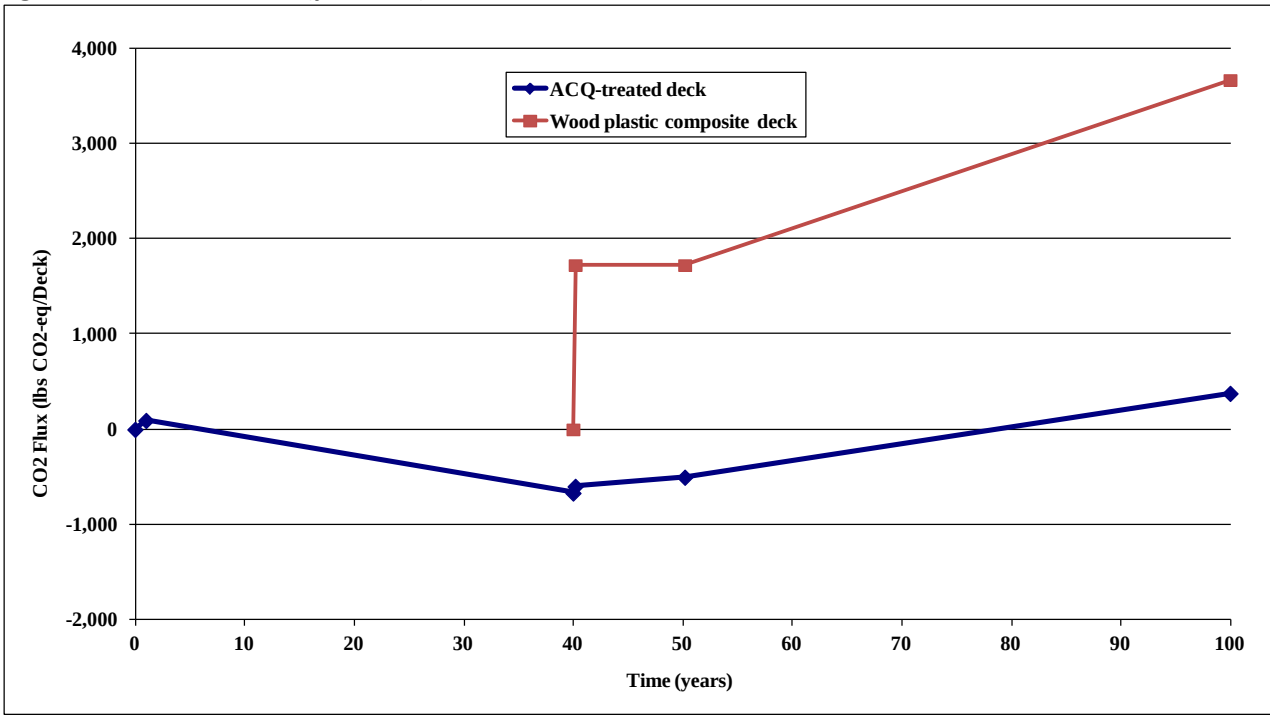
| Impact category | Units | ACQ-treated lumber deck | WPC deck |
|---|---|---|---|
| Energy use | | | |
| Energy input from technosphere | MMBTU | 0.23 | 1.4 |
| Energy input from nature | MMBTU | 0.18 | 2.1 |
| Biomass energy | MMBTU | 0.15 | 0.0083 |
| Impact indicators | | | |
| GHG emissions | lb-$CO_2$-eq | 114 | 330 |
| Acid rain potential | lb-H+ mole-eq | 24 | 105 |
| Smog potential | g NOx / m | 0.11 | 0.28 |
| Air emission ecotoxicity | lb-2,4-D-eq | 0.25 | 0.43 |
| Eutrophication | lb-N-eq | 0.013 | 0.015 |
| Resource use | | | |
| Fossil fuel use | MMBTU | 0.24 | 3.4 |
| Water use | gal | 12 | 34 |

The carbon balance of ACQ-treated lumber decking and wood plastic composite decking, through the life cycle stages, is shown in Figure 3. Wood products begin their life cycles removing carbon from the atmosphere (as carbon dioxide) and atmospheric carbon removal continues as trees grow during their approximate 40-year growth cycle, providing an initial life cycle carbon credit. Approximately half the mass of dry wood fiber is carbon. WPC is composed of wood from recovered/recycled cellulose fiber materials and virgin and/or waste plastics.

Transportation and manufacturing operations are the primary sources of carbon emissions in the manufacture of wood products. Wood plastic composites require the conversion of fossil fuels into plastics for virgin materials and collection and processing of wood scrap. Some manufacturers of wood plastic composites use recycled plastics however, burdens associated with transportation, sorting, cleaning, and melting must be included.

During use, this assessment assumes that one application of sealant is applied to the ACQ-treated lumber deck. Minimal carbon use or release occurs during use of wood plastic composites. Following the service life stage, both ACQ-treated lumber decking and wood plastic composite decking are assumed to be disposed in a landfill.

**Figure 3 Carbon balance (per deck)**




## 8. Additional Information

This study is further detailed in a Procedures and Findings Report completed November 3, 2009 and is available upon request from the Treated Wood Council at www.treated-wood.org/contactus.html.

This study has been published in the peer reviewed *Journal of Cleaner Production* and is available at http://dx.doi.org/10.1016/j.jclepro.2010.12.004.