Generic Cedar Siding

Product Selection and Description

Cedar wood is used for exterior siding because it is a lightweight, low-density, aesthetically-pleasing material that provides adequate weatherproofing. As with most wood products, cedar siding production consists of three major steps. First, roundwood is harvested from logging camps. Second, logs are sent to sawmills and planing mills where the logs are washed, debarked, and sawed into planks. The planks are edged, trimmed, and dried in a kiln. The dried planks are then planed and the lumber sent to a final trimming operation. Finally, the lumber from the sawmill is shaped into fabricated, milled wood products.

For the BEES system, beveled cedar siding 1.3 cm (½ in) thick and 15 cm (6 in) wide is studied. Cedar siding is assumed to be installed with galvanized nails 41 cm (16 in) on center and finished with one coat of primer and two coats of stain. Stain is reapplied every 10 years.

Flow Diagram

The flow diagram below shows the major elements of the production of this product, as it is currently modeled for BEES.

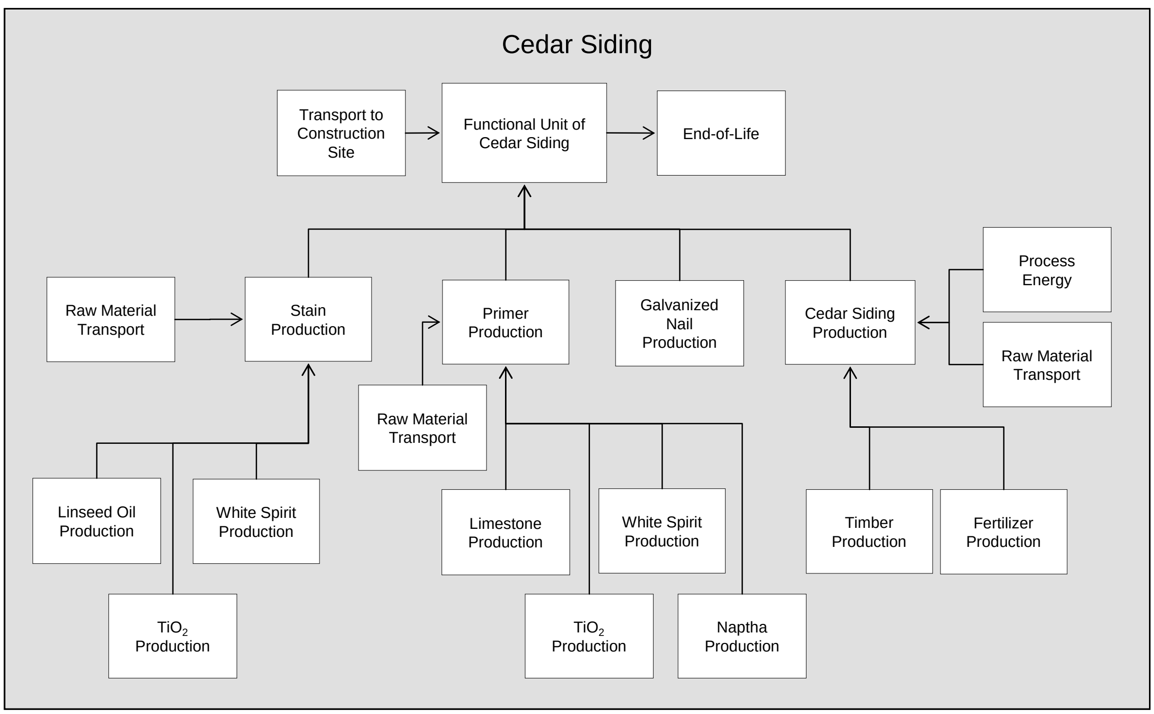

Figure 1: Cedar Siding System Boundaries

Raw Materials

CORRIM lumber production data was used to model cedar wood production. This dataset includes environmental burdens from growing and harvesting softwood logs for forest management in the Pacific Northwest.[1]

The growing and harvesting of wood is modeled as a composite comprised of a mix of low-, medium-, and high-intensity managed timber. Energy use for wood production includes electricity for greenhouses to grow

[1] Bowyer, J., et. al., *Phase I Final Report: Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction*. (Seattle, WA: Consortium for Research on Renewable Industrial Materials--CORRIM, Inc./University of Washington, 2004). Found at: http://www.corrim.org/reports600+ pp.; data also submitted to US LCI Database.

seedlings, gasoline for chain saws, diesel fuel for harvesting mechanical equipment, and a small amount of fertilizer. Emissions associated with production and combustion of gasoline and diesel fuel and those from the production and delivery of electricity are based on the U.S. LCI Database. Fertilizer production data is adapted from European data in the U.S. LCI Database. Electricity use for greenhouse operation is based on the grids for the region where the seedlings are grown, while the U.S. average electricity grid is used for fertilizer production. The weight of wood harvested for lumber is based on an average oven-dry density of 509.77 kg/m^3 (31.824 lb/ft^3).

BEES modeling accounts for the absorption of carbon dioxide by trees as they grow; the carbon becomes part of the wood, and the oxygen is released to the atmosphere. The "uptake" of carbon dioxide from the atmosphere during the growth of timber is about 1.84 kg (4.06 lb) of carbon dioxide per kilogram of harvested wood (oven-dry weight).

Manufacturing

Energy Requirements and Emissions. The energy requirements allocated to the production of softwood lumber for cedar siding are listed in the Table below. These requirements are based on average manufacturing conditions in the U.S. Pacific Northwest (PNW). The energy comes primarily from burning wood and bark waste generated in the sawmill process. Other fuel sources include natural gas for boilers, and propane and diesel for forklifts and log haulers at the sawmill. The production and combustion of the different types of fuel are based on the U.S. LCI Database.

Table 1: Cedar Siding Production Energy

Energy Carrier	***Quantity per lb Cedar Siding***
Electricity - PNW Grid	4.68E+05 J (0.13 kWh)
Natural Gas	4.53E-03 m^3 (0.16 ft^3)
Diesel fuel	2.01E-03 L (5.3E-04 gal)
LPG	1.21E-03 L (3.2E-04 gal)
Hogfuel/Biomass	1.90E-01 kg (0.42 lb)

Allocated process-specific air emissions from lumber production are based on the CORRIM study, as reported in the Table below. Allocation is based on mass and a multi-unit process analysis to correctly assign burdens. Note: In the BEES model, CO_2 generated by combustion of biofuel (hogged wood fuel) and fossil fuel are tracked separately since CO_2 from biomass is considered environmentally impact-neutral by the U.S. EPA, and as such is not considered when determining the Global Warming Potential impact.

Table 2: Cedar Siding Production Process-Related Emissions

Air Emission	***Emissions per lb Cedar Siding***
Particulates (unspecified)	1.36E-05 kg (3.0E-05 lb)
VOC (unspecified)	8.62E-05 kg (1.9E-04 lb)

Transportation. Since sawmills are typically located close to the forested area, transportation of raw materials to the sawmill is not taken into account. Transport of primer and stain to the manufacturing plant is included.

Transportation

Transportation of cedar siding by heavy-duty truck to the building site is modeled as a variable of the BEES system.

Installation
Cedar siding installation is predominately a manual process--a relatively tiny amount of energy may be required to operate compressors to power air guns, but this amount is assumed to be too small to warrant inclusion in the analysis. Installation waste with a mass fraction of 5 % is assumed, and all waste is assumed to go to landfill.

Cedar siding panels are attached using galvanized nails. Three nails are required per 0.09 m^2 (per ft^2) of siding. Assuming standard 6d 5 cm (2 in) nails, installation requires 0.0054 kg (0.0119 lb) of nails per ft^2 of siding. No installation waste is assumed for the nails.

After installation, the siding is primed and stained. The primer is modeled as a standard primer with coverage of 46.4 m^2 (500 ft^2) per gal; the stain is assumed to have coverage of 32.5 m^2 (350 ft^2) per gal. One coat of primer and two coats of stain are applied to the siding.

While sheathing, weather resistive barriers, and other ancillary materials may be required to complete the exterior wall system, these materials are not included in the system boundaries for BEES exterior wall finishes.

Use

The density of cedar siding at 12 % moisture content is assumed to be 449 kg/m^3 (28 lb/ft^3). The product is assumed to have a useful life of 40 years. To prolong the lifetime and maintain the appearance of the siding, two coats of stain are assumed to applied every 10 years. Information on typical cleaning practices (e.g., frequency of cleaning, types and quantities of cleaning solutions used) is not available; cleaning is not included in the system boundaries.

End of Life
All of the cedar siding is assumed to be disposed of in landfill at end of life. The practice of recycling wood building materials is increasing, but data is not available to quantify this practice.

References
Life Cycle Data
National Renewable Energy Laboratory (NREL): *U.S. Life-Cycle Inventory Database*. 2005. Golden, CO. Found at: http://www.nrel.gov/lci/database.

PRé Consultants: *SimaPro 6.0 LCA Software*. 2005. The Netherlands.

Bowyer, J., et. al., *Phase I Final Report: Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction*. (Seattle, WA: Consortium for Research on Renewable Industrial Materials. (CORRIM, Inc.)/University of Washington, 2004). Found at: http://www.corrim.org/reports.

Industry Contacts

No industry contacts were identified to provide further insight on this product.