

CertainTeed Corporation Siding Products

CertainTeed Corporation manufactures building materials that include roofing, vinyl and fiber cement siding, trim, fence, railing, decking, foundations, insulation, gypsum, ceilings, and pipe products. CertainTeed has approximately 70 facilities throughout the United States and Canada. Five of CertainTeed's siding products are evaluated in BEES:

CertainTeed vinyl siding. CertainTeed's vinyl siding product in BEES is modeled as an average of its vinyl siding product lines manufactured at its Jackson, MI, and Hagerstown, MD, plants. Bills of materials and manufacturing data were collected from these two facilities and averaged on a weighted basis, based on vinyl siding output. This vinyl siding has a nominal thickness of 0.11 cm (0.044 in) and a mass ranging from 17.83 kg to 21.79 kg (39.4 lb to 48.2 lb) per 9.29 m² (100 ft²). Consistent with the generic vinyl siding product in BEES, it is typically installed with galvanized nail fasteners placed 41 cm (16 in) on center.

CertainTeed Recycled Content CedarBoards (D6). The CedarBoards Double 6" Clapboard product is a vinyl siding product with expanded polystyrene (EPS) foam backing for added insulation. The vinyl siding, containing both post-industrial and post-consumer content PVC resin, has the semblance of a rough cedar finish, and has a nominal thickness of 0.11 cm (0.044 in). It is produced at CertainTeed's Jackson, MI, plant, and is sent to another facility to be laminated onto the insulated foam. Its mass ranges from 18.61 kg to 22.75 kg (41.0 lb to 50.2 lb) per 9.29 m² (100 ft²) and it is typically installed with galvanized nail fasteners placed 41 cm (16 in) on center. It has a thermal resistance value of 2.9 according to thermal testing results by an independent testing company.¹ Despite the added insulation, the building still requires base insulation. Thermal performance differences among exterior wall finish alternatives are not accounted for in BEES, but should be considered when interpreting BEES results.

CertainTeed Cedar Impressions siding is a polypropylene (PP) resin-based siding with the semblance and texture of cedar panels. With a mass ranging from 34.4 kg to 42.0 kg (75.6 lb to 92.4 lb) per 9.29 m² (100 ft²) and a thickness of 1.25 cm (0.10 in), Cedar Impressions is manufactured at CertainTeed's McPherson, KS, plant. It is typically installed with galvanized nail fasteners placed 26.7 cm (10.5 in) on center.

CertainTeed WeatherBoards siding with and without recycled content are two fiber cement-based siding products offered by CertainTeed. WeatherBoards are available in laps, panels, shingles, and individual shakes. The products evaluated in BEES, representing the majority of the volume of their fiber cement siding sold, are lap siding of 21.96 cm (8.25 in) wide and 0.79 cm (0.31 in) thick. Installed, they have a 17.8 cm (7.0 in) reveal with 3.18 cm (1.25 in) of overlap. WeatherBoards with recycled content have a density of 12.45 kg/m² (2.55 lbs/ft²); installed density is 14.89 kg/m² (3.05 lbs/ft²). Densities for WeatherBoards without recycled content are about 5 % higher: 13.07 kg/m² (2.68 lbs/ft²) and 15.63 kg/m² (3.20 lbs/ft²), respectively. WeatherBoards are typically installed with galvanized nail fasteners placed 41 cm (16 in) on center and the boards are painted. They are manufactured at CertainTeed's Roaring River, NC, plant.

¹ Architectural Testing, Inc. *Computer Simulation Thermal Performance Test Report* rendered to CertainTeed Corporation on CedarBoards Double 6 model, 2/16/09.

Flow Diagrams

The flow diagrams below show the major elements of the production of these five products as they are currently modeled for BEES.

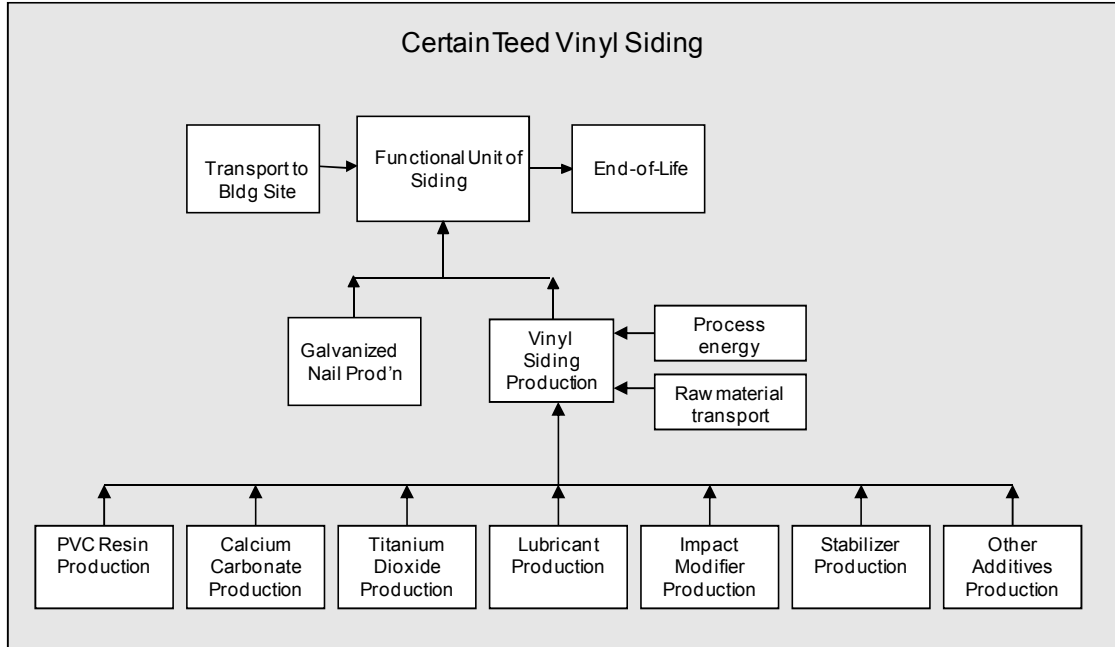


Figure 1: CertainTeed Vinyl Siding System Boundaries

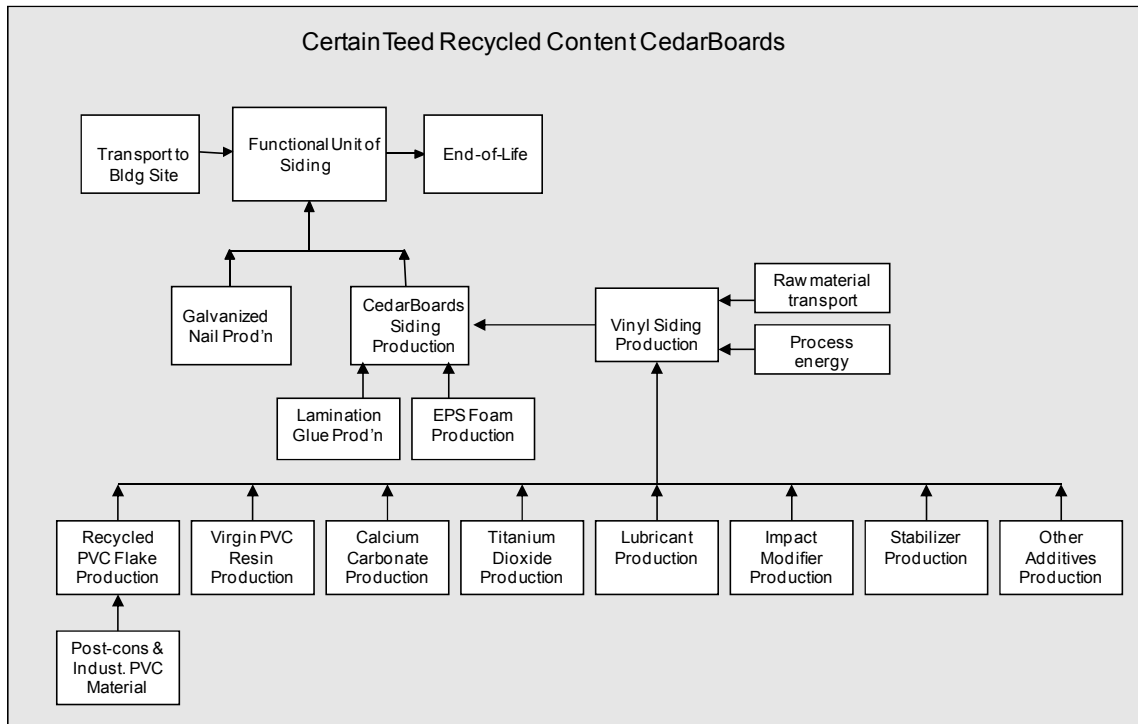


Figure 2: CertainTeed Recycled Content CedarBoards System Boundaries

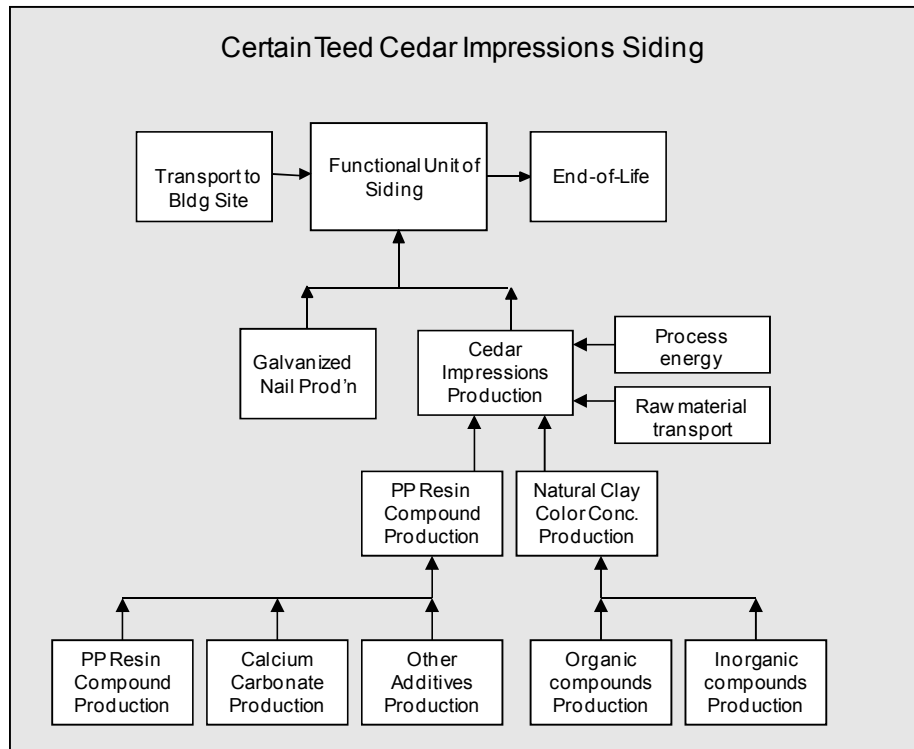


Figure 3: CertainTeed Cedar Impressions System Boundaries

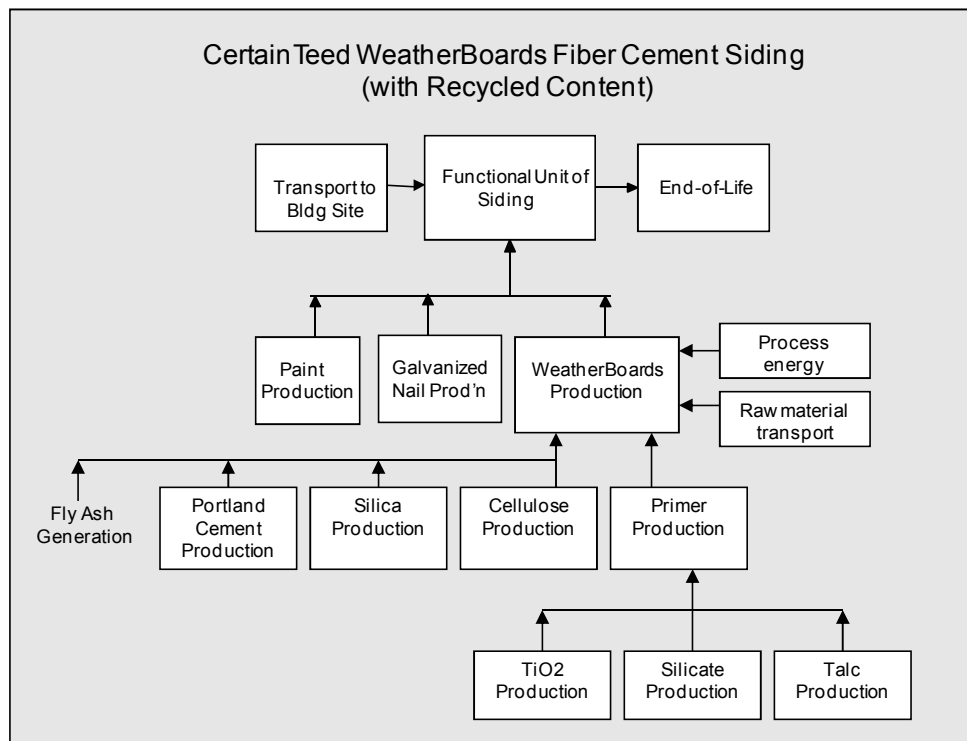


Figure 4: CertainTeed WeatherBoards With Recycled Content System Boundaries

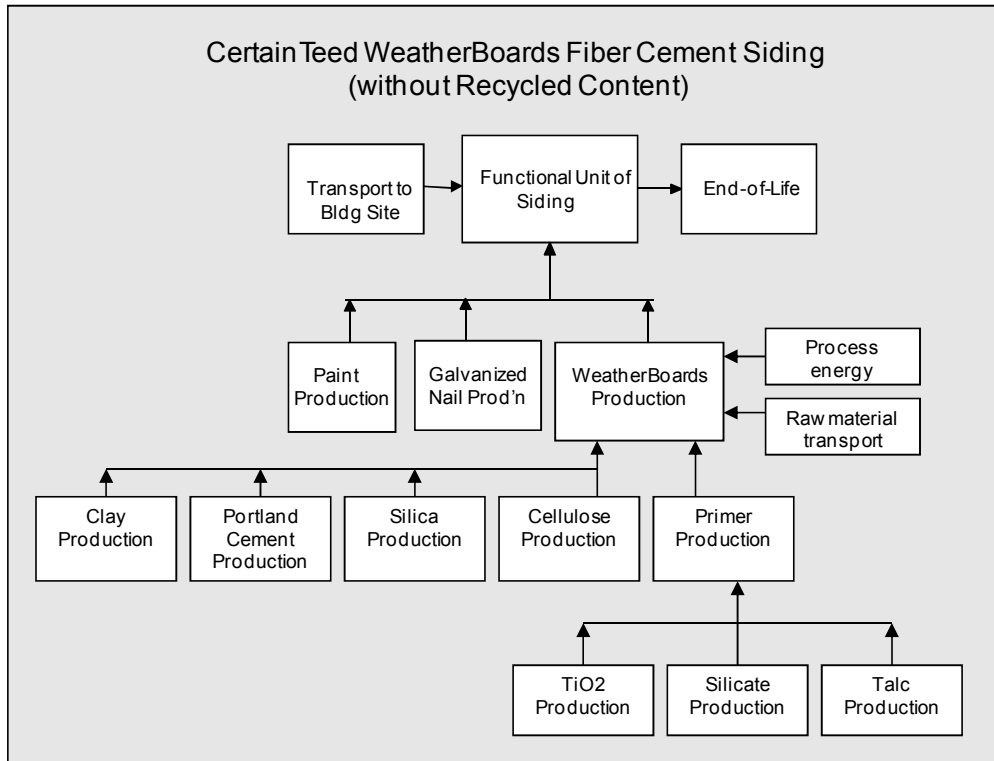


Figure 5: CertainTeed WeatherBoards Without Recycled Content System Boundaries

Raw Materials

CertainTeed Vinyl Siding. The CertainTeed vinyl siding product is made up of the following materials:

Table 1: Vinyl Siding Constituents (Weighted Average)

Constituent	% in the Siding
PVC resin	73.9 – 90.3 %
Calcium carbonate	8.6 – 10.5 %
Acrylic-based additives	2.8 – 3.4 %
Titanium dioxide	1.5 – 1.9 %
Lubricant	1.4 – 1.7 %
Other additives	1.8 – 2.2 %
Total	100 %

The PVC resin is based on CertainTeed’s own formulation and manufacturing of the resin. Data for the formulation are not provided in this documentation to protect company confidential data but all elements of that model are based on U.S. LCI database, the EcoInvent database, and the SimaPro database. Production data for the other materials in the table are based on the same databases. “Other additives” include pigment, impact modifiers, stabilizers, and process aids. Data for all of the materials were provided in Material Safety Data Sheets (MSDS); their

production data are included in the LCA model but are excluded from this documentation to protect company confidential data.

Recycled Content CedarBoards. Recycled Content CedarBoards are comprised of three main components: EPS foam, vinyl siding, and lamination glue, as shown in the table below.

Table 2: Recycled Content CedarBoards Siding Constituents

Constituent	% in the Siding
Foam backing	10.4 – 12.8 %
CertainTeed vinyl siding with recycled content	78.8 – 96.3 %
Lamination glue	0.8 – 1.0 %

The foam backing is EPS foam board insulation produced by Progressive Foam. The data for the raw materials and production of this foam can be found in the documentation for Progressive Foam’s insulated siding.

The recycled content vinyl siding is produced at the Jackson, MI, plant. The table above on CertainTeed average vinyl siding provides the main bill of materials for the siding, with one exception: 74.3 % of the PVC resin is recycled. According to CertainTeed’s supplier, the recycled content PVC resin comes from both post-industrial (vinyl siding and window manufacturers), and post-consumer (scrap, end of life siding and construction tear-down). The recycler cleans and shreds the incoming material and produces recycled PVC flakes. General mass balance data were supplied by the recycler. Since primary data on recycling energy could not be obtained from the supplier, polyethylene terephthalate (PET) bottle recycling process energy was used as a proxy.² While the energy to shred and reclaim PET bottles may be very different from PVC reclamation processes, the Franklin data are primary data from four reclamation plants in the U.S., and these data are considered to be of very good quality based on data quality evaluation in the report. The table below provides the recycling energy assumed for PVC recycling.

Table 3: PVC Flake Recycling Energy³

Energy Source	Quantity per kg PVC flake
Electricity (MJ)	1.66
Natural Gas (MJ)	2.88
LPG & propane (MJ)	0.0076

Energy data come from the U.S. LCI Database. The average distance the post-industrial and post-consumer vinyl feedstock is transported to the recycler is 1 609 km (1 000 mi); this is included in the model. The lamination glue is made up of the following components, obtained from the MSDS.

² Franklin Associates, *Life Cycle Inventory of 100% Post-Consumer HDPE and PET Recycled Resin from Post-Consumer Containers and Packaging* (Prairie Village, KS: American Chemistry Council, Inc., *et al.*, April 2010).

³ Franklin Associates (2010), Table 2-9 on PET bottle reclamation.

Table 4: Lamination Glue Constituents

Constituent	% by mass
Tackifying Resins	42.3 % to 51.7 %
Mineral Oil	18.0 % to 22.0 %
Polymer Solids	24.3 % to 29.7 %
Carbonic Acid	2.7 % to 3.3 %
Talc	2.7 % to 3.3 %

This glue emits no VOCs, according to the MSDS. The materials in the glue were modeled based on elements of the U.S. LCI database, the EcoInvent database, and the SimaPro database.

Cedar Impressions Siding. Two material mixes are blended together to form Cedar Impressions siding, as shown below.

Table 5: Cedar Impressions Constituents

Constituent	% in the Siding
Polypropylene (PP) resin compound	88.0 % to 100 %
Natural clay color concentrate	0.0 % to 2.4 %

The PP resin compound is made up of PP resin, calcium carbonate filler, and other additives. The natural clay color concentrate is made up of approximately 50 % inorganic, mineral-based compounds and 50 % organic compounds. The full bills of materials for these compounds have been included in the model but are not provided in this documentation to protect company-confidential data. Production data for materials is based on elements of the U.S. LCI database, the EcoInvent database, and the SimaPro database.

Table 6: WeatherBoards Constituents

Constituent	With Recycled Content % by mass	Without Recycled Content % by mass
Portland Cement	30 % to 37 %	34 % to 39 %
Fly ash	30 % to 50 %	N/A
Kaolin clay	N/A	2 % to 7 %
Silica	14 % to 34 %	48 % to 53 %
Cellulose	6 % to 10 %	6 % to 10 %
Primer	0.2 %	0.2 %

The data on Portland Cement and pulpwood-based cellulose come from the U.S. LCI Database. Fly ash is a waste material that results from burning coal to produce electricity which could also be considered to be a byproduct of coal combustion. Because it would be disposed of if not used beneficially elsewhere, fly ash is assumed to be an environmentally “free” input material. Transport of the fly ash to CertainTeed has been included in the model. The kaolin clay data come from EcoInvent. The silica – silicic acid/calcium salt, or calcium silicate – has been modeled based on stoichiometry of the reactants water glass and slaked lime, which come from

elements of the SimaPro and EcoInvent databases. The primer consists of titanium dioxide, sodium potassium/aluminum silicate, and talc – whose data come from elements of the SimaPro and EcoInvent databases. A loss rate of 6.4 % of all materials except for the primer has been accounted for in the modeling.

Manufacturing – CertainTeed Vinyl Siding, Recycled Content CedarBoards, and Cedar Impressions

The manufacturing energy for CertainTeed’s vinyl siding, recycled content CedarBoards, and Cedar Impressions is presented in the table below.

Table 7: Energy Requirements for CertainTeed Vinyl- and PP-based Products

<i>Energy source</i>	<i>Quantity per functional unit of product</i>		
	<i>Average vinyl siding</i>	<i>Recycled Content Cedarboards</i>	<i>Cedar Impressions</i>
Electricity (MJ)	0.282 – 0.344	0.376 – 0.460	0.041 – 0.051
Natural Gas (MJ)	0.028 – 0.034	0.324 – 0.396	0.225 – 0.275
Propane (MJ)	0.009 – 0.011	0.077 – 0.094	0.020 – 0.024

Electricity is used to blend the ingredients in the products, propane is used for forklifts, and natural gas is used for plant heating. Electricity production fuels, natural gas, and propane production and combustion come from the U.S. LCI Database. The following table summarizes other manufacturing-related data:

Table 8: Other Process Data for CertainTeed Vinyl- and PP-based Products

<i>Process Input or Output</i>	<i>Quantity per functional unit of product</i>		
	<i>Average vinyl siding</i>	<i>Recycled Content Cedarboards</i>	<i>Cedar Impressions</i>
Input: Water use (L)	0.317 – 0.387	0.559 – 0.683	0.706 – 0.862
Output: Wastewater (L)	0.214 – 0.262	0.409 – 0.499	0.599 – 0.733
Output: Waste (kg)	0.010 – 0.012	0.005 – 0.007	0.002 – 0.002

The water is used for product cooling and to run the cooling towers. The wastewater, discharged to the sewer, comes directly from the cooling water use; the discrepancy between the reported water in and out is due to evaporation losses, and this water is assumed to be uncontaminated.

There are no manufacturing/product losses; the CertainTeed facilities have systems in place to recycle or recover and use all of the floor sweepings and product scrap. For example, the Cedar Impressions scrap is recycled into a part of packaging pallets used throughout CertainTeed plants. The solid waste is non-hazardous material composed of unrecyclable packaging, cafeteria trash, and other miscellaneous trash, and it is landfilled.

Combustion-related air emissions are accounted for in upstream energy use data sets (e.g., natural gas use in a boiler). According to CertainTeed, no other process-related air emissions are generated from these processes.

Lamination of Recycled Content CedarBoards. After the CedarBoards vinyl siding has been manufactured, it is sent to Beach City, OH to be laminated. The vinyl siding sheets and EPS foam board are hand fed onto a table of rollers. Lines of glue are applied to the foam and then the foam and vinyl are run through a compression roller sealing the foam to the vinyl. The final product is boxed and shipped. The whole process relies primarily on human labor, with only a small amount of electricity being used for the roller machine. This electricity is included as part of the foam production process described in the Progressive Foam insulated siding Raw Materials section. Transportation by heavy-duty diesel truck from Jackson, MI to Beach City, OH (394 km, or 245 mi) is included in the model.

Transportation of CertainTeed Vinyl Siding constituents. Transportation of the raw materials in CertainTeed’s average vinyl siding to the two manufacturing locations has been accounted for, and a weighted average taken based on total production. The PVC resin is transported by rail a distance of less than 2500 km (1553 mi) to both locations. The remaining materials are transported by heavy-duty diesel truck, and transportation distances are up to 3000 km (1864 mi). All transportation modes are modeled based on the U.S. LCI Database.

Transportation of Recycled Content CedarBoards constituents. Transportation of the raw materials in the recycled content vinyl siding to the Jackson plant has been accounted for. Once manufactured, the siding is transported 394 km (245 mi) by heavy-duty diesel truck from Jackson, MI, to Beach City, OH, to be laminated. The lamination glue is transported a distance of less than 1000 km (621 mi) to Beach City. The transportation of the raw materials to Beach City to produce EPS foam is included in the foam production model. All transportation modes are modeled based on the U.S. LCI Database.

Transportation of Cedar Impressions constituents. Transportation of the raw materials to CertainTeed has been accounted for. The PP resin compound is transported by rail a distance of less than 1500 km (932 mi) and the natural clay color concentrate is transported by heavy-duty truck a distance of less than 1000 km (621 mi). All transportation modes are modeled based on the U.S. LCI Database.

Manufacturing – CertainTeed WeatherBoards With and Without Recycled Content

WeatherBoards are produced by creating a slurry with water and the raw materials. Electricity is used for this blending. The slurry is then shaped into the WeatherBoards boards which are subsequently dried in the “kiln” using natural gas heat. Gasoline, diesel, and propane fuels are used in various facility vehicles, including forklifts. A summary of the manufacturing energy for CertainTeed WeatherBoards is presented in the table below.

Table 9: Energy Requirements for WeatherBoards

<i>Energy source</i>	<i>MJ per functional unit</i>	
	<i>With Recycled Content</i>	<i>No Recycled Content</i>
Electricity	0.810 – 1.07	0.857 - 1.12
Natural Gas	2.12 – 2.16	2.23 – 2.26
Diesel Oil	0.036	0.038

Gasoline	0.002	0.002
Propane	0.014 – 0.017	0.014 – 0.017

Electricity production fuels, natural gas, and the other fuels’ production and combustion come from the U.S. LCI Database. The following table summarizes other manufacturing-related data:

Table 10: Other Process Data for WeatherBoards

Process Input or Output	Quantity per functional unit	
	With Recycled Content	No Recycled Content
Input: Water use (l)	0.414 – 0.711	0.442 – 0.739
Output: Waste (kg)	0.086 – 0.094	0.091 – 1.000

Water is used to form the slurry. No water emissions are generated as the water from the slurry evaporates; the Roaring River facility is a zero-discharge facility. Solid waste includes process losses at the plant which are landfilled. Process-related air emissions are generated from processing WeatherBoards. These are included in the model but not in this documentation. Combustion-related air emissions are accounted for in upstream energy use data sets (e.g., from natural gas use in the kiln).

Transportation of CertainTeed WeatherBoards constituents. Transportation of the raw materials to Roaring River, NC have been accounted for, with distances by diesel truck ranging from 290 km (180 mi) to 724 km (450 mi). The primer is shipped 434 km (270 mi) by rail. One of the materials is shipped approximately 5 000 km (3 108 mi) by ocean freighter to a port on the U.S. east coast and then trucked the remaining distance. All transportation modes are modeled based on the U.S. LCI Database.

Transportation of Products to Installation

Transportation of CertainTeed Vinyl Siding and Recycled Content Cedarboards to Installation. These finished products are transported an average of 1400 km (870 mi) by diesel truck to their respective building sites. The nails used at installation are assumed to be transported 241 km (150 mi) by diesel truck to the building sites. The BEES user is free to change the assumed transport distances for the main products.

Transportation of CertainTeed Cedar Impressions to Installation. The finished Cedar Impressions siding is transported an average of 3 620 km (2 250 mi) by diesel truck to the building site. The nails used at installation are assumed to be transported 241 km (150 mi) by diesel truck to the building site. The BEES user is free to change the assumed transport distance for Cedar Impressions.

Transportation of CertainTeed WeatherBoards to Installation. The finished WeatherBoards siding is transported an average of 950 km (590 mi) by diesel truck to the building site. Both the nails and the paint used at installation are assumed to be transported 241 km (150 mi) by diesel truck to the building site. The BEES user is free to change the assumed transport distance for WeatherBoards transport to the building site.

Installation

Installation of the CertainTeed products is done primarily by manual labor. These products are modeled as being installed with nails and a nail gun to be consistent with other siding products in BEES. The CertainTeed products are also commonly installed with a hammer and nails. For the vinyl-based sidings and WeatherBoards, nails are installed 41 cm (16 in) on center. The nails are modeled as galvanized steel, and for installation 41 cm (16 in) on center, 0.026 kg/m² (0.005 lb/ft²) of siding is used. Cedar Impressions are installed with galvanized steel nails 26.7 cm (10.5 in) on center. For installation 26.7 cm (10.5 in) on center, 0.04 kg/m² (0.008 lb/ft²) of siding is used. The energy required to operate compressors to power air guns and circular saws for cutting is assumed to be very small and is not included in the analysis. In addition to nails, WeatherBoards require two coats of paint at installation: 0.094 kg/m² (0.019 lb/ft²). Data for paint production and manufacturing can be found in the BEES documentation for virgin paint.

The model assumes an average installation waste of 5 % by mass for each product, and this waste is assumed to go to a landfill. 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 Phase

Since CertainTeed offers homeowners a limited lifetime warranty of 50 years for all these products, they are modeled as having useful lives of 50 years. Thus, one initial installation and use period is modeled for the BEES functional lifetime. WeatherBoards are modeled as being repainted with one coat of paint every seven years, for a total of seven additional paint coatings over the course of 50 years. No other routine maintenance is required to prolong the lifetime of the products, although cleaning is recommended to maintain appearance. Cleaning would normally be done with water and household cleaners. Information on typical cleaning practices (e.g., frequency of cleaning, types and quantities of cleaning solutions used) was not available. Besides paint needed for WeatherBoards, maintenance is not included in the system boundaries.

End-of-Life

Each of these products is assumed to be disposed of in a landfill at end of life.

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 7.0 LCA Software*. 2005. The Netherlands.

Ecoinvent Centre, *Ecoinvent data v2.0* (Dübendorf: Swiss Centre for Life Cycle Inventories, 2007), retrieved from: www.ecoinvent.org.

Franklin Associates, *Life Cycle Inventory of 100% Post-Consumer HDPE and PET Recycled Resin from Post-Consumer Containers and Packaging* (Prairie Village, KS: American Chemistry Council, Inc., et al., April 2010).

Industry Contacts

Jesse Sherry, Brendan McGrath, Sustainable Solutions Corporation (February 2010, March 2011)