CertainTeed

Restoration Millwork® Trim

Life Cycle Assessment Report

CertainTeed
SAINT-GOBAIN

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Introduction

The CertainTeed Siding Group manufactures exterior PVC trim products. CertainTeed is actively pursuing strategies to reduce their environmental impact and to increase the sustainability of their operations and products. CertainTeed has developed a corporate sustainability strategy for reducing energy use, water use and waste, and has conducted Life Cycle Assessments of the PVC trim products in order to better understand and to improve these products. Life Cycle Assessment (LCA) is a method for identifying the environmental impacts of a product, process or activity over its entire lifespan, including extraction and processing of raw materials, manufacturing, transportation and distribution, installation, use, maintenance, and end of life including recycling and final disposal. LCA is a primary tool of the CertainTeed Sustainable Product Development program and is integral to our product stewardship initiatives.

To provide full transparency and make this data available to the public, CertainTeed has decided to submit their data to the Building for Economic and Environmental Sustainability (BEES) program. BEES Online is a software program designed by the National Institute of Standards and Technology (NIST) that allows the comparison of building products on a life cycle basis. NIST fully reviews and investigates each product LCA to ensure that the data is correct and accurate. CertainTeed is the first manufacturer to publish exterior trim products in the BEES database. The graphs and tables showing the environmental impact of Restoration Millwork were produced using BEES online data, and all data submitted to BEES undergoes the thorough reviews required under ISO 14040 standards for the comparison of product using LCA data. For more information or to utilize BEES Online directly, go to http://ws680.nist.gov/Bees/. The information in this report is taken directly from the BEES program, unless otherwise noted, to assist the reader with evaluating CertainTeed PVC Trim Products using LCA.

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Life Cycle Assessment

Life Cycle Assessment is an analytical tool used to quantify and interpret the flows to and from the environment (including emissions to air, water and land, as well as the consumption of energy and other material resources) over the entire life cycle of a product (or process or service). By including the impacts throughout the product life cycle, LCA provides a comprehensive view of the environmental aspects of the product and an accurate picture of the environmental costs and benefits of product selection.

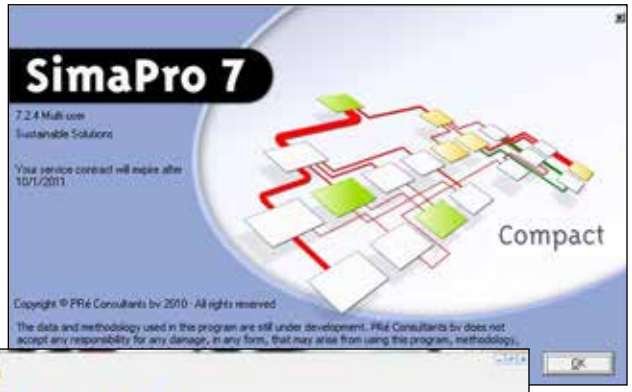
An LCA is generally conducted in four phases: (1) goal and scope definition, (2) life cycle inventory (LCI), (3) life cycle impact assessment, and (4) interpretation. An LCA starts with determining the scope of the study, functional unit, system boundaries, assumptions and limitations, allocation methods used, and impact categories. In the inventory analysis, a flow model of the technical system is constructed using data on inputs and outputs. The input and output data needed for the construction of the model are collected (such as resources, energy requirements, emissions to air and water, and waste generation for all activities within the system boundaries). Then, the environmental impacts are calculated and analyzed in relation to the functional unit. Inventory analysis is followed by impact assessment, where the LCI data are characterized in terms of their potential environmental impacts (e.g., acidification, eutrophication, and global warming potential effects).

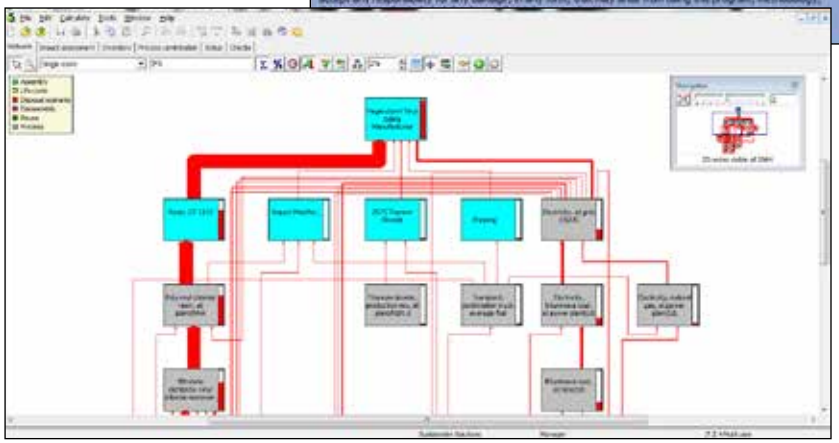
Functional Unit

The functional unit is of great importance in an LCA. It provides a unit of analysis and comparison for all environmental impacts. The functional unit is based on the use and life of the product; for trim, this is typically expressed in terms of length for a given time period. BEES uses a functional unit for trim products of 1 foot of trim over a 50 year lifespan to establish the ability to compare multiple building products.

Modeling Software

The complete trimboard cradle-to-grave LCI was measured at the production facility in Social Circle, Georgia. All process data including inputs (raw materials, energy and water) and outputs (emissions, waste water, solid waste and final products) are evaluated and modeled to represent each process that contributes to the life cycle of CertainTeed PVC trimboards. The study's geographical and technological coverage has been limited to North America, except for raw materials manufactured outside this region. SimaPro 7 software was used to generate life cycle impact assessment (LCIA) results utilizing the BEES impact assessment methodology.





CertainTeed PVC Trimboards

Product Description

CertainTeed PVC Trimboard products are evaluated in BEES for the Exterior Trim category. The trimboards are modeled as an average of CertainTeed's trimboard embossed finishes manufactured at its Social Circle, Georgia, Restoration Millwork Plant. The product in BEES is 1 in. (2.54 cm) thick by 6 in. (15.24 cm) wide, with a mass of approximately 1 lb (0.454 kg) per 1 ft (0.30 m). The functional unit is 1 linear foot of trim used for 50 years with an average lifespan of 25 years so that one replacement is included in the service life. The trimboards are installed using four galvanized finishing nails per foot of product.

Figure 1. CertainTeed PVC Trimboard products

Raw Materials

CertainTeed PVC Trimboards are composed of the following materials:

Table 1. CertainTeed PVC Trimboard Constituents (Weighted Average)

Constituent	Weighted Average % in the Trim
PVC resin	1-65 %
Internal regrind	1-25 %
External regrind	1-25 %
Recycled Content PVC	1-50 %
Calcium carbonate	1-20 %
Acrylic-based additives	1-5 %
Titanium dioxide	1-5 %
Other additives	1-5 %
Total	**100 %**

The PVC resin is based on the U.S. LCI database. Internal regrind is finished product scrap that is sent to a regrind silo within the Social Circle, Georgia facility, where it is introduced back into the product. The energy consumption for this is included in the manufacturing energy described below. External regrind is the same material but is instead sent off-site to be reground. The round-trip transportation of this product – 1 122 km (697 mi) – has been accounted for in addition to the grinding energy which was provided by the processing facility, specifically: 0.0015 kg natural gas per kg regrind and 0.123 kWh electricity per kg regrind.

CertainTeed purchases a pulverized recycled cellular PVC material consisting of pre- and post-consumer waste. Because this is a recovered waste product, it is modeled as free of upstream production, with the exception of transportation pertaining to the collection of the foam, pulverization of the recycled materials into useful form, and transportation of the material to CertainTeed. The same energy used for the external regrind has been assumed due to lack of precise data on the pulverization energy. This assumption is conservative, as the pulverization energy may be less due to the softness of the recycled foam.

Production data for the other materials in the table are based on the U.S. LCI or EcoInvent databases. "Other additives" include pigment, stabilizer, blowing agent, process aid, and lubricants. Data for the supplier-specific materials are 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.

Manufacturing

CertainTeed PVC Trimboards are produced by extrusion. Manufacturing energy for CertainTeed PVC Trimboards are presented in the table below.

Table 7. Energy Requirements for the PVC Trimboards

Energy Source	Quantity per ft
Electricity (kWh)	0.385
Natural Gas (MJ)	0.192
Propane (MJ)	0.037

The electricity is used for raw materials mixing, extrusion, machining, lighting, air compressors, cooling water pumps, grinding operations, and other miscellaneous equipment. The natural gas usage is used only for space heating, and the propane is used in the forklifts. 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 PVC Trimboards

Process Input or Output	Quantity per ft
Input: Water use (L)	0.156
Output: Wastewater (L)	0.096
Output: Solid waste (kg)	0.008
Output: Waste oil (kg)	1.0 E-5

The water is used to replenish evaporative loss in the cooling towers and for overhead/domestic and other miscellaneous uses. The wastewater, discharged to the sewer, comes mainly from overhead/domestic and other miscellaneous uses; the discrepancy between the reported water in and out is mainly due to evaporation losses in the closed loop cooling water system. This water is assumed to be uncontaminated.

There is no product loss during manufacturing; CertainTeed collects any scrap product and regrinds it to make new product. A small amount of off-spec product is collected and sent to an off-site recycler to be integrated into other products. The solid waste is non-hazardous miscellaneous plant waste that is landfilled. The waste oil from plant machinery goes to a nearby hazardous waste operation where it is incinerated.

Combustion-related air emissions are accounted for in upstream energy use data sets (e.g., natural gas use in a boiler). Particulate matter is generated during the process (in the sawing operations, for example), but these are immediately suctioned into a vacuum system and sent back to the regrind silo where it is introduced back into the product formulation. The facility uses a closed pneumatic transfer system for all of their raw materials (silo to mixer to hopper to extruder) which minimizes material loss. The facility is exempt from reporting air emissions so other potential emissions are not reported.

Transportation of Trimboard Constituents

Transportation of the raw materials in the trimboards has been accounted for. The PVC resin is transported by rail a distance of 1,117 km (694 mi). The remaining materials are transported by heavy-duty diesel truck, and transportation distances range from 724 km (450 mi) to 5,150 km (3,200 mi). All transportation modes are modeled based on the U.S. LCI Database.

Transportation of Products to Installation

The finished product is transported an average of 930 miles (1,497 km) by diesel truck to the building site. The nails used at installation are assumed to be transported 150 miles (241 km) by diesel truck. The BEES user is free to change the assumed transport distance for the main product.

Installation

Installation is done primarily by manual labor. The most common fastener for this product is an 8d finishing nail (2.5 in. (6.35 cm) long) with a weight of 0.005 lb (0.0024 kg). Four nails are used per foot of installed product, for a total weight of 0.02 lb (0.0096 kg). The nails are modeled as galvanized steel. While the purchased product does not ever need to be painted, it can be if desired. This model does not include painting of the product.

The model assumes an average installation waste of 6.5 %, and this waste is assumed to go to a landfill.

Use Phase

Since CertainTeed offers homeowners a limited lifetime warranty of 25 years, this product is modeled as having a useful life of 25 years. Thus, one initial installation and one replacement are modeled for the BEES functional lifetime. No routine maintenance is required to prolong the lifetime of the product, 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.

End–of-Life

At the end of life, this product is assumed to be disposed of in a landfill.

System Boundary

This project considers the life cycle activities from resource extraction through product use, inclusive of maintenance and replacement and end-of-life effects.

The study system boundary includes the transportation of major inputs to (and within) each activity stage including the shipment of final products to the building site, based on logistics data provided by CertainTeed, by common modes as well as transportation to a landfill at the end of the service life. Any site-generated energy and purchased electricity is included in the system boundary. The extraction, processing and delivery of purchased primary fuels (e.g., natural gas and primary fuels used to generate purchased electricity) are also included within the boundaries of the system. Purchased electricity consumed at various site locations is modeled based on US grid averages, using the models published in the NREL US LCI database. Ancillary material use (e.g., nails for installation) is also included within the system boundary.

Cut-off Criteria

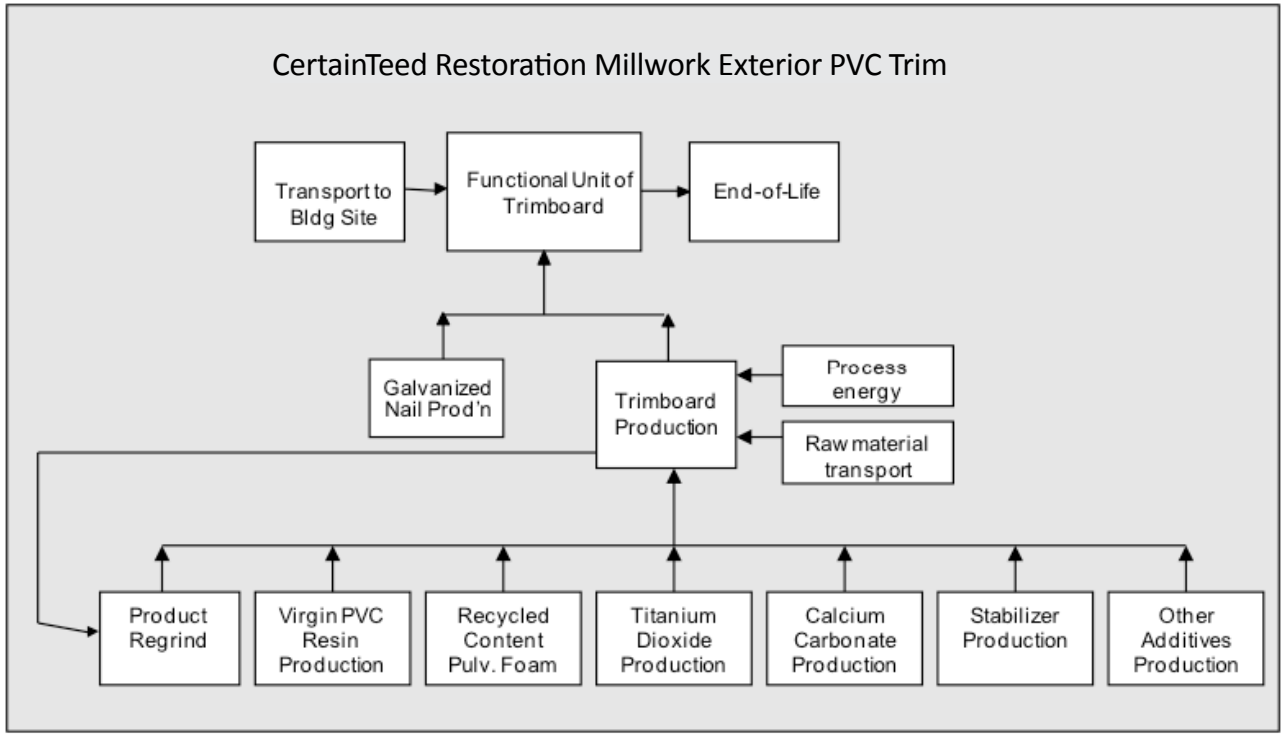
The cut-off criteria for input flows to be considered within each system boundary were as follows:

a) Mass – if a flow is less than 1% of the cumulative mass of the model flows it may be excluded, providing its environmental relevance is minor.

b) Energy – if a flow is less than 1% of the cumulative energy of the system model it may be excluded, providing its environmental relevance is minor.

c) Environmental Relevance – if a flow meets the above two criteria, but is determined (via secondary data analysis) to contribute 2% or more to a product life cycle impact category (see below), it is included within the system boundary.

Figure 2. CertainTeed PVC Trimboard Boundaries



LCA Results

BEES Impact Methodology

The Building for Economic and Environmental Sustainability (BEES) impact methodology was used for all calculations of environmental impact. BEES was developed by the National Institute of Standards and Technology (NIST) as a tool for selecting cost-effective, environmentally-preferable building products. The specific impact categories included in BEES are described below:

Global Warming Potential – Carbon dioxide and other greenhouse gasses are emitted at every stage in the life cycle. These gasses can trap heat close to the Earth, contributing to global warming.

Acidification – Acidification is a more regional, rather than global, impact affecting fresh water and forests as well as human health when high concentrations of SO_2 are attained. Acidification is a result of processes that contribute to increased acidity of water and soil systems.

Human Health: Cancer & Non-cancer – This impact assesses the potential health impacts of more than 200 chemicals. These health impacts are general, based on emissions from the various life cycle stages, and do not take into account increased exposure that may take place in manufacturing facilities. For measuring the potential contribution to cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of benzene equivalents. For measuring contribution to health impacts other than cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of toluene equivalents.

Criteria Air Pollutants – This impact measures the amounts of criteria air pollutants: nitrogen oxides, sulfur oxides, and particulate matter.

Eutrophication – Eutrophication is the fertilization of surface waters by nutrients that were previously scarce. When a previously scarce or limiting nutrient is added to a water body, it leads to the proliferation of aquatic photosynthetic plant life. This may lead to the water body becoming hypoxic, eventually causing the death of fish and other aquatic life.

Ecotoxicity – The ecological toxicity impact measures the potential of a chemical released into the environment to harm terrestrial and aquatic ecosystems.

Smog – Under certain climatic conditions, air emissions from industry and transportation can be trapped at ground level where, in the presence of sunlight, they produce photochemical smog, a symptom of photochemical ozone creation potential (POCP). While ozone is not emitted directly, it is a product of interactions of volatile organic compounds (VOCs) and nitrogen oxides (NOx).

Fossil Fuel Depletion – This impact measures the extraction of fossil fuels (petroleum, coal, and natural gas).

Indoor Air Quality – It measures the effects of products on the air quality inside buildings, primarily through the measurement of volatile organic compound (VOC) emissions.

Habitat Alteration – This impact measures the potential for land use by humans to lead to damage of Threatened and Endangered Species. In BEES, habitat alteration is assessed based on the amount of waste sent to landfill through the life of the product and at the point of final disposal.

Water Intake – This impact measures water withdrawn from the groundwater or municipal system.

Ozone Depletion – Certain chemicals, when released into the atmosphere, can cause depletion of the ozone layer, which protects the Earth and its inhabitants from certain types of harmful radiation. This impact measures the releases of those chemicals.

In order to combine the environmental impacts categories above, a judgment was made about the relative importance of the environmental impact categories. The BEES impact assessment methodology weighting system is based on a volunteer stakeholder panel assembled by the National Institute of Standards and Technology (NIST) which included seven producers (i.e., building product manufacturers), seven users (i.e., green building designers), and five LCA experts. The relative weight of each impact category is shown in Table 4 below.

Table 4. BEES Overall Assessment Methodology Impact Categories and Relative Weightings

Impact Category	Unit	Weighting
Global Warming	g CO_2 eq	29%
Fossil Fuel Depletion	MJ surplus	10%
Criteria Air Pollutants	microDALYs	9%
Human Health Cancer	g C_6H_6 eq	8%
Water Intake	liters	8%
Ecological Toxicity	g 2,4-D eq	7%
Eutrophication	g N eq	6%
Habitat Alteration	T&E count	6%
Human Health Non-cancer	g C_7H_7 eq	5%
Smog	g NOx eq	4%
Acidification	H+ moles eq	3%
Indoor Air Quality	kg TVOC eq	3%
Ozone Depletion	g CFC-11 eq	2%

Overall Environmental Impact

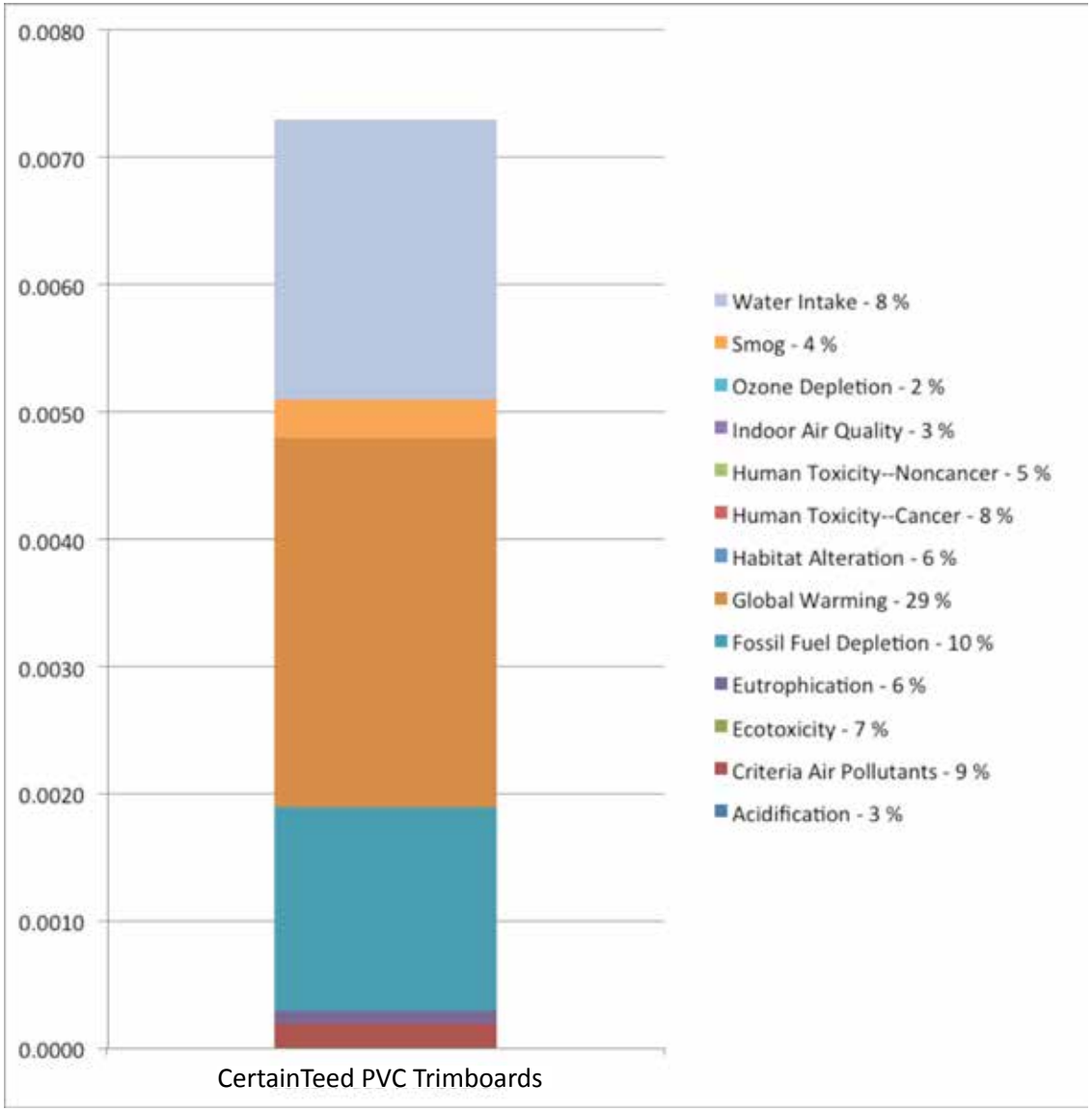
The tables and graphs below were generated using the BEES Online Software and display the overall environmental impact of the CertainTeed PVC Trimboards. As CertainTeed is the first manufacturer to publish exterior trim in BEES, there are no other products shown in these results as a reference. The results are a composite score based on all of the impact categories described above combined and weighted according to the values in Table 4 above. The overall score is unitless and is useful only for comparing products; however, many of the impact categories are illustrated in more detail in Appendix A. It is important to remember that the lower the score, the lower the environmental impact.

Table 5. Overall Environmental Impact of Various CertainTeed PVC Trimboards

Category	CertainTeed PVC Trimboards
Acidification – 3%	0.0000
Criteria Air Pollutants – 9%	0.0002
Ecotoxicity – 7%	0.0000
Eutrophication – 6%	0.0001
Fossil Fuel Depletion – 10%	0.0016
Global Warming – 29%	0.0029
Habitat Alteration – 6%	0.0000
Human Toxicity: Cancer – 8%	0.0000
Human Toxicity: Noncancer – 5%	0.0000
Indoor Air Quality – 3%	0.0000
Ozone Depletion – 2%	0.0000
Smog – 4%	0.0003
Water Intake – 8%	0.0022
Sum	0.0073

Overall Environmental Impact (continued)

Figure 4. Overall Environmental Impact of CertainTeed PVC Trimboards



Economic Performance

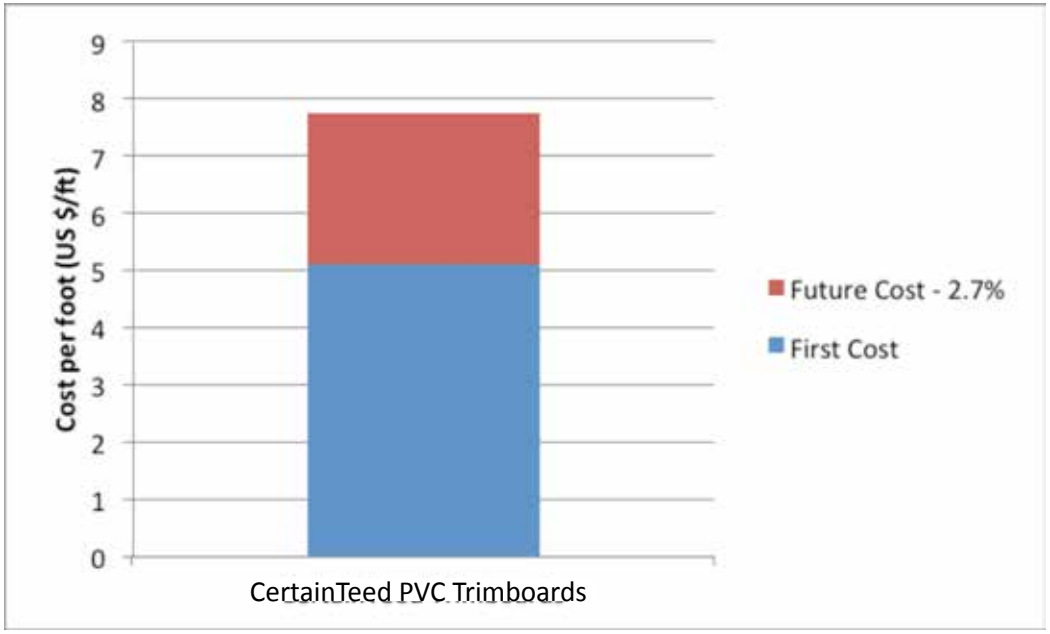
Economic performance is evaluated beginning at product purchase and installation because this is when out-of-pocket costs begin to be incurred, and investment decisions are made based upon out-of-pocket costs. In the BEES model, economic performance is measured over a 50-year study period. Life Cycle Costing (LCC) is the method used for the economic analysis. This method sums over the study period all relevant costs associated with a product. Categories of cost typically include costs for purchase, installation, operation, maintenance, repair, and replacement.

Table 6. Economic Performance of CertainTeed PVC Trimboards

Category	CertainTeed PVC Trimboard
First Cost	$5.11
Future Cost	$2.63
Sum	$7.74

The following provides more detail on the environmental impacts of CertainTeed PVC Trimboards. All of these graphs and tables were produced using BEES Online and additional data can be obtained by going to http://ws680.nist.gov/Bees/.

Figure 5. Economic Performance of CertainTeed PVC Trimboards



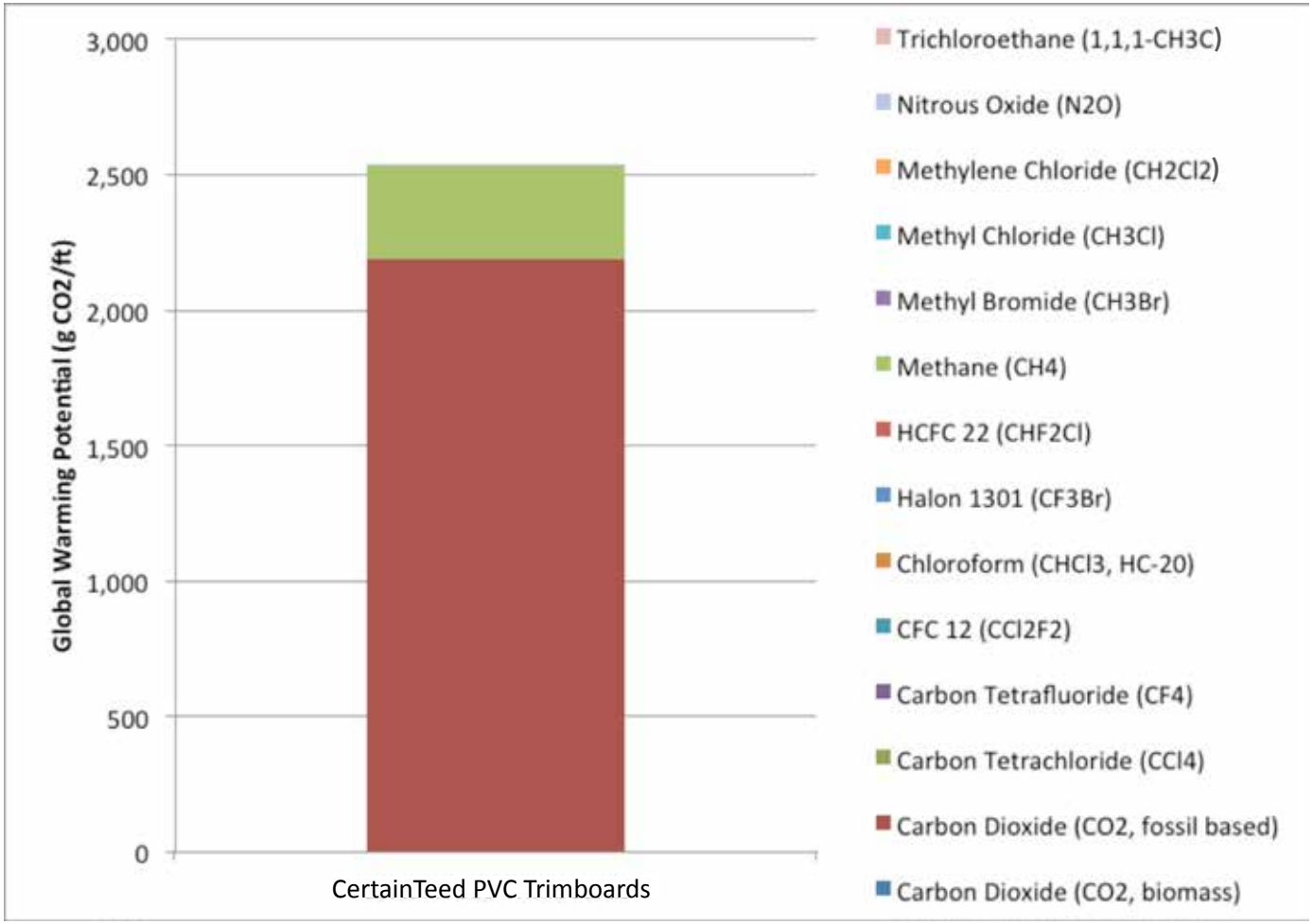
Global Warming Potential

Carbon dioxide and other greenhouse gasses are emitted at every stage in the manufacturing process. These gasses can trap heat close to the Earth, contributing to global warming.

Table 7. Global Warming Potential (g CO_2 eq)

Category	CertainTeed PVC Trimboards
Carbon Dioxide – biomass	0.7342
Carbon Dioxide – fossil	2186.3228
Carbon Tetrachloride	0.1208
Carbon Tetrafluoride	0.0269
CFC 12	0.0002
Chloroform	0
Halon 1301	0.0023
HCFC 22	0.0047
Methane	344.5008
Methyl Bromide	0
Methyl Chloride	0.0001
Methylene Chloride	0.0007
Nitrous Oxide	7.015
Trichloroethane	0
Sum	2538.7285

Figure 6. Global Warming Potential (g CO_2 eq)



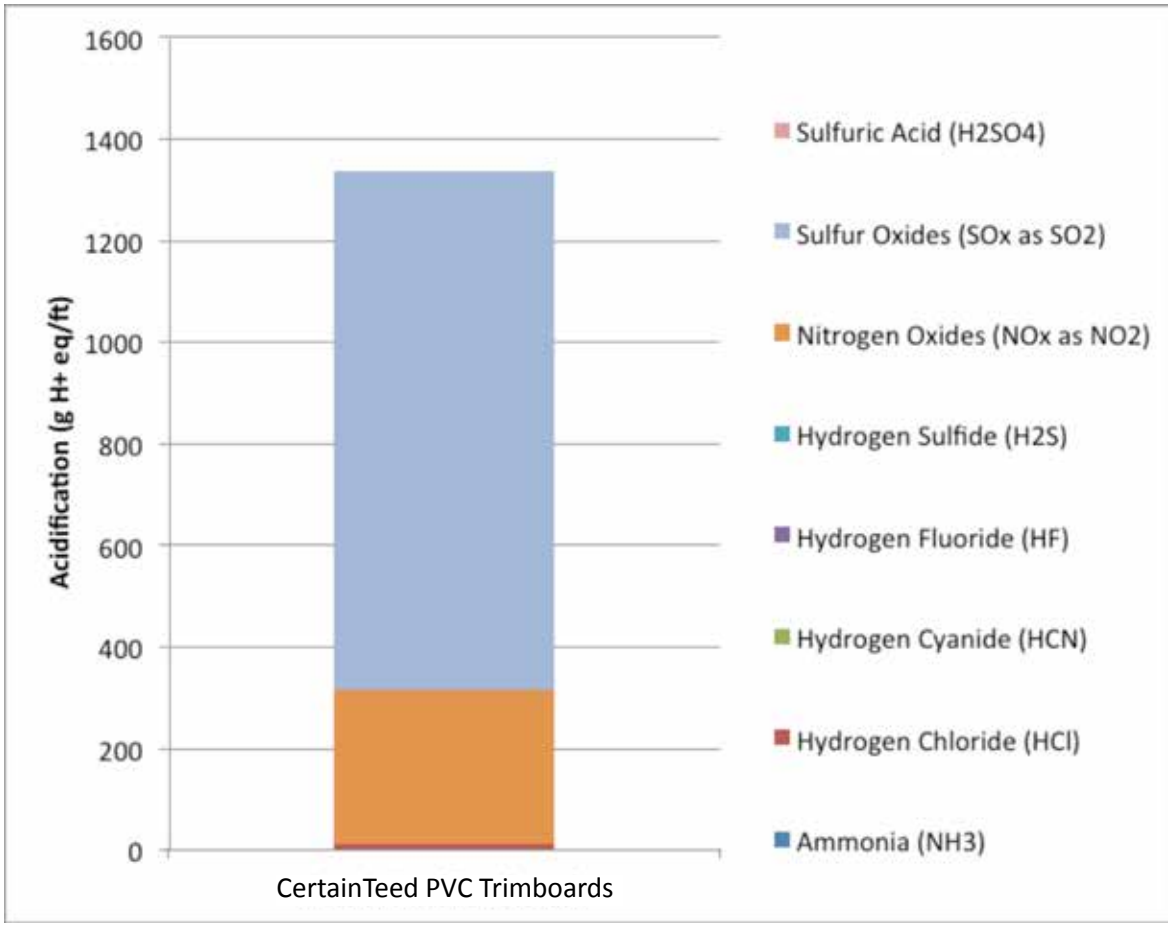
Acidification

Acidification is a more regional, rather than global, impact affecting fresh water and forests as well as human health when high concentrations of SO_2 are attained. Acidification is a result of processes that contribute to increased acidity of water and soil systems. The acidification potential of an air emission is calculated on the basis of the number of H+ ions that can be produced and, therefore, is expressed as potential H+ equivalents on a mass basis.

Table 8. Acidification (H+ moles eq)

Category	CertainTeed PVC Trimboards
Ammonia	0.6810
Hydrogen Chloride	10.5541
Hydrogen Cyanide	0.0010
Hydrogen Fluoride	2.3458
Hydrogen Sulfide	0.0359
Nitrogen Oxides	304.0745
Sulfur Oxides	1017.7808
Sulfuric Acid	0.0000
Sum	1335.4731

Figure 7. Acidification (H+ moles eq)



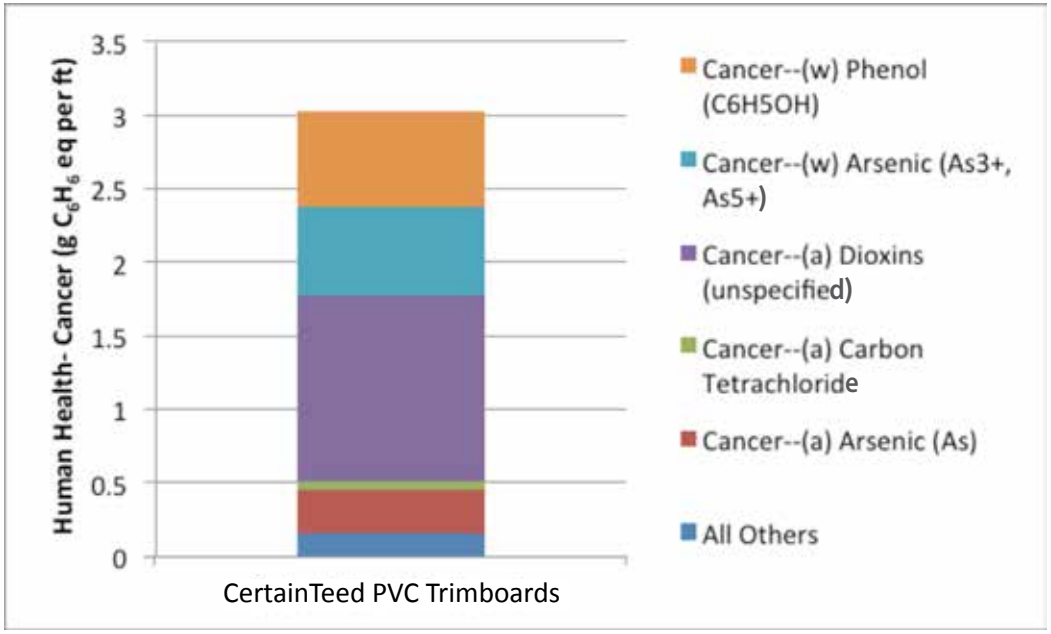
Human Health: Cancer

This impact assesses the potential health impacts of more than 200 chemicals. These health impacts are general, based on emissions from the various life cycle stages and do not take into account increased exposure that may take place in manufacturing facilities. For measuring the potential contribution to cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of benzene equivalents. Uncertainty exists with measuring any correlation to health impacts; these results benchmark the potential impacts of particular substances, but due to the uncertainty may not directly cause these health impacts. It's important to remember that all product systems have environmental and health impacts and CertainTeed is embracing product transparency through this disclosure and strives to continually improve the environmental and health performance of its products.

Table 9. Human Health: Cancer (g C_6H_6 eq)

Category	CertainTeed PVC Trimboard
All Others	0.1526
Arsenic (As)	0.3031
Benzene	0.0552
Dioxins	1.2668
Arsenic (As3+, As5+)	0.5994
Phenol	0.6509
Sum	3.028

Figure 8. Human Health: Cancer (g C_6H_6 eq)



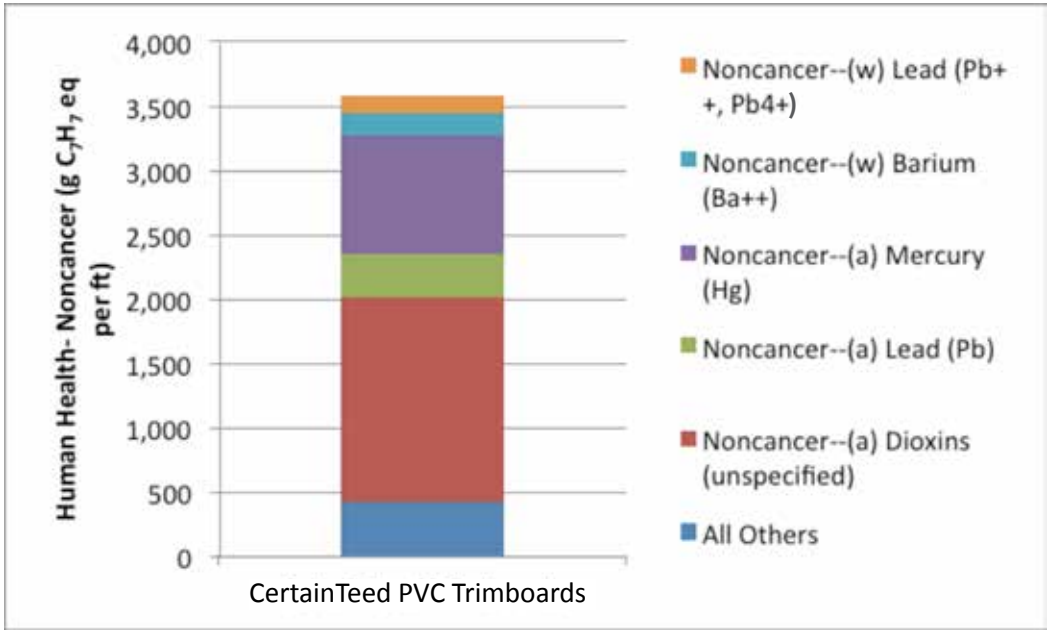
Human Health: Non-Cancer

This impact assesses the potential health impacts of more than 200 chemicals. These health impacts are general, based on emissions from the various life cycle stages and do not take into account increased exposure that may take place in manufacturing facilities. For measuring contribution to health impacts other than cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of toluene equivalents. Uncertainty exists with measuring any correlation to health impacts; these results benchmark the potential impacts of particular substances, but due to the uncertainty may not directly cause these health impacts. It's important to remember that all product systems have environmental and health impacts and CertainTeed is embracing product transparency through this disclosure and strives to continually improve the environmental and health performance of its products.

Table 10. Human Health: Non-Cancer (g C_6H_6 eq)

Category	CertainTeed PVC Trimboard
All Others	422.1060
Cadmium	1595.9339
Dioxins	337.7134
Mercury	921.0371
Barium	164.4531
Lead	144.0633
Sum	3585.3068

Figure 10. Human Health: Non-Cancer (g C_6H_6 eq)



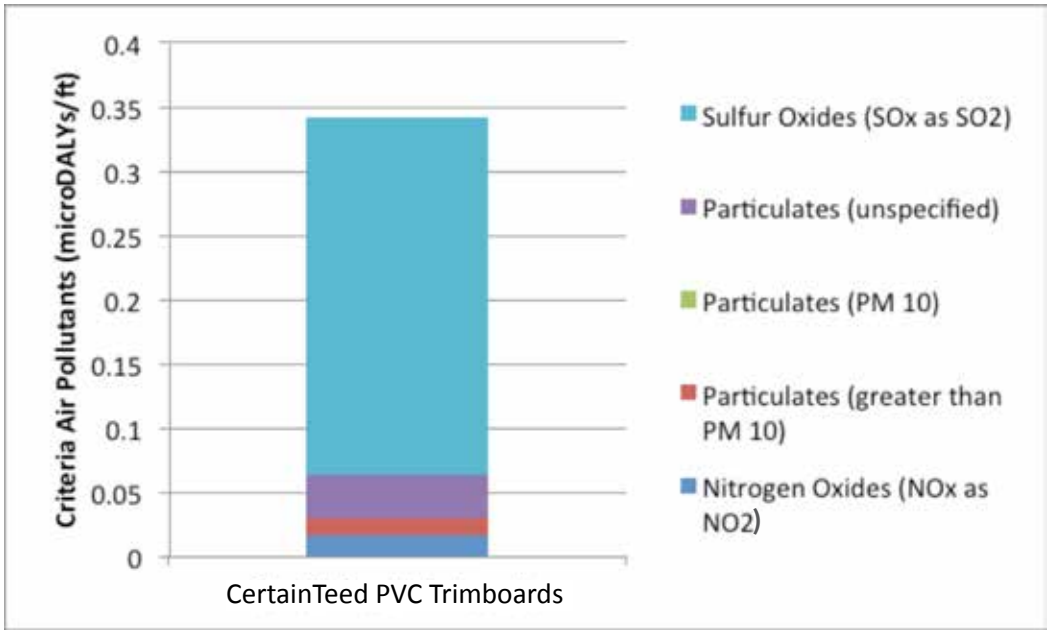
Criteria Air Pollutants

This impact measures the amounts of criteria air pollutants: nitrogen oxides, sulfur oxides, and particulate matter.

Table 11. Criteria Air Pollutants (microDALYs)

Category	CertainTeed PVC Trimboard
Nitrogen Oxides	0.0168
Particulates (greater than)	0.0132
Particulates (PM 10)	0.0000
Particulates (unspecified)	0.0337
Sulfur Oxides	0.2787
Sum	0.3424

Figure 12. Criteria Air Pollutants (microDALYs)



Eutrophication

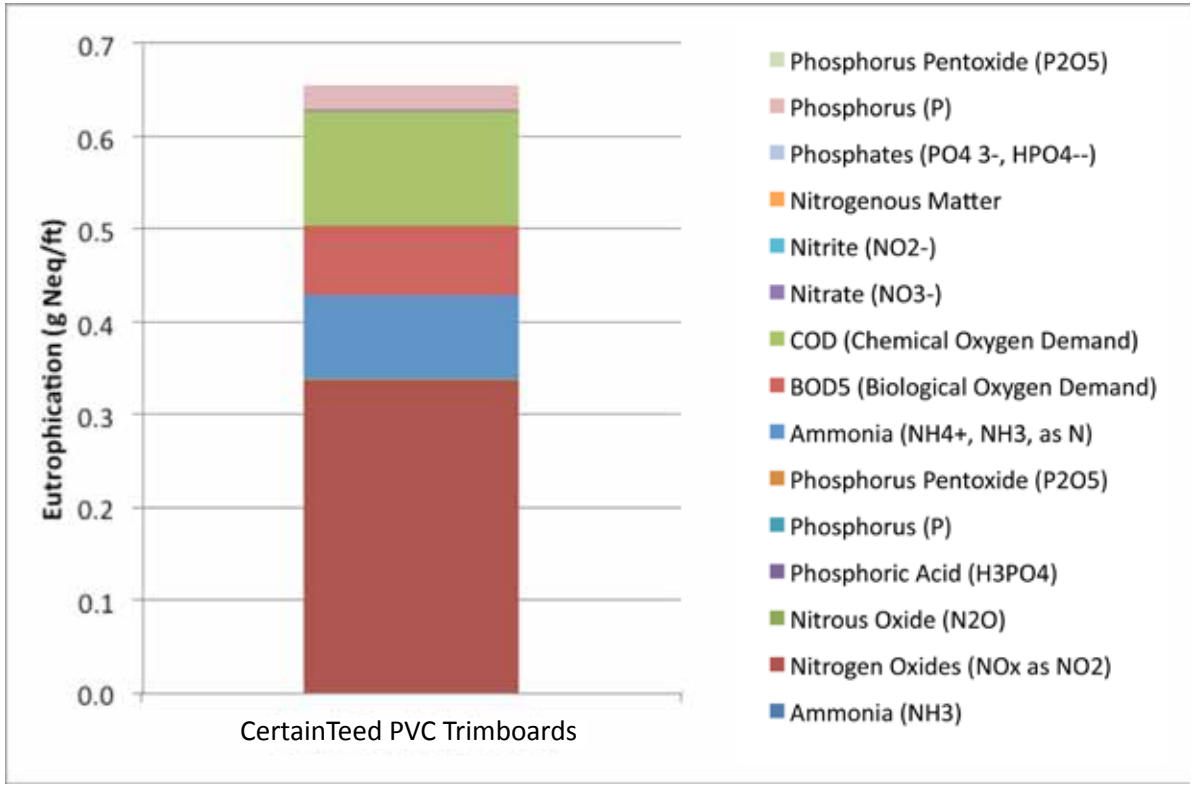
Eutrophication is the fertilization of surface waters by nutrients that were previously scarce. When a previously scarce or limiting nutrient is added to a water body, it leads to the proliferation of aquatic photosynthetic plant life. This may lead to the water body becoming hypoxic, eventually causing the death of fish and other aquatic life. This impact is expressed on an equivalent mass of nitrogen (N) basis.

Table 12. Eutrophication (g N eq)

Category	CertainTeed PVC Trimboards
Ammonia (NH3)	0.0008
Nitrogen Oxides (NOx as NO2)	0.3364
Nitrous Oxide (N2O)	0.0022
Phosphoric Acid (H3PO4)	0.0000
Phosphorus (P)	0.0000
Phosphorus Pentoxide (P2O5)	0.0000
Ammonia (NH4+, NH3, as N)	0.0894
BOD5	0.0751
COD (Chemical Oxygen Demand)	0.1235
Nitrate (NO3-) (as water emission)	0.0013
Nitrite (NO2-) (as water emission)	0.0000
Nitrogenous Matter (as water emission)	0.0000
Phosphates (PO4 3-, HPO4--,) (as water emission)	0.0000
Phosphorus (P) (as water emission)	0.0260
Phosphorus Pentoxide (P2O5) (as water emission)	0.0000
Sum	0.6547

Eutrophication (continued)

Figure 13. Eutrophication (g N eq)



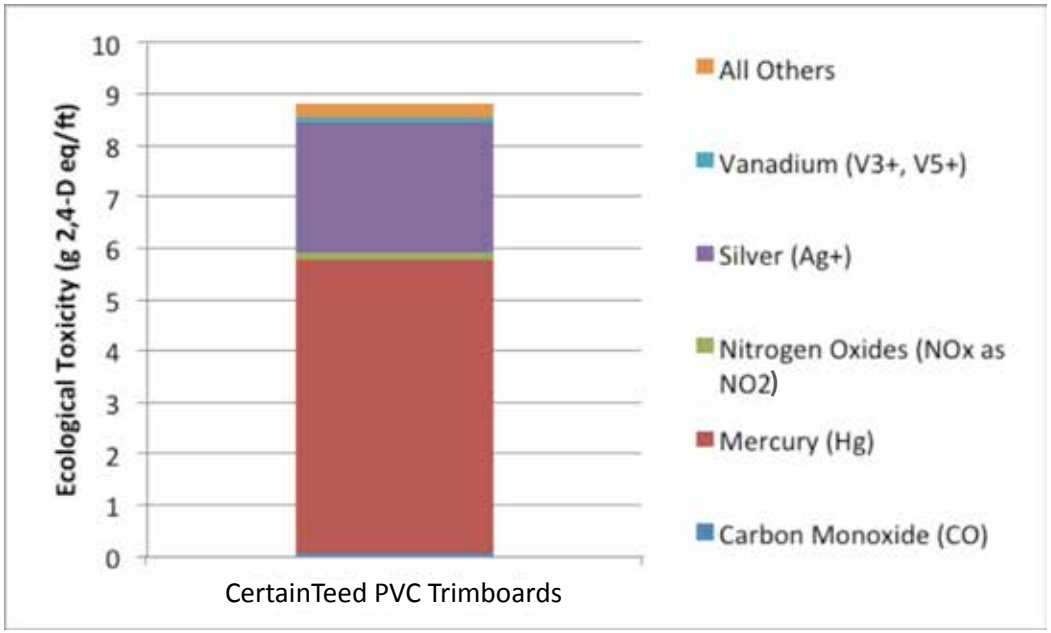
Ecological Toxicity

The ecological toxicity impact measures the potential of a chemical released into the environment to harm terrestrial and aquatic ecosystems.

Table 13. Ecological Toxicity (g 2,4-D eq)

Category	CertainTeed PVC Trimboard
Carbon Monoxide	0.0830
Dioxins	5.6806
Mercury	0.1557
Nitrogen Oxides	2.5280
Silver	0.0905
All Others	0.2775
Sum	8.8153

Figure 14. Ecological Toxicity (g 2,4-D eq)



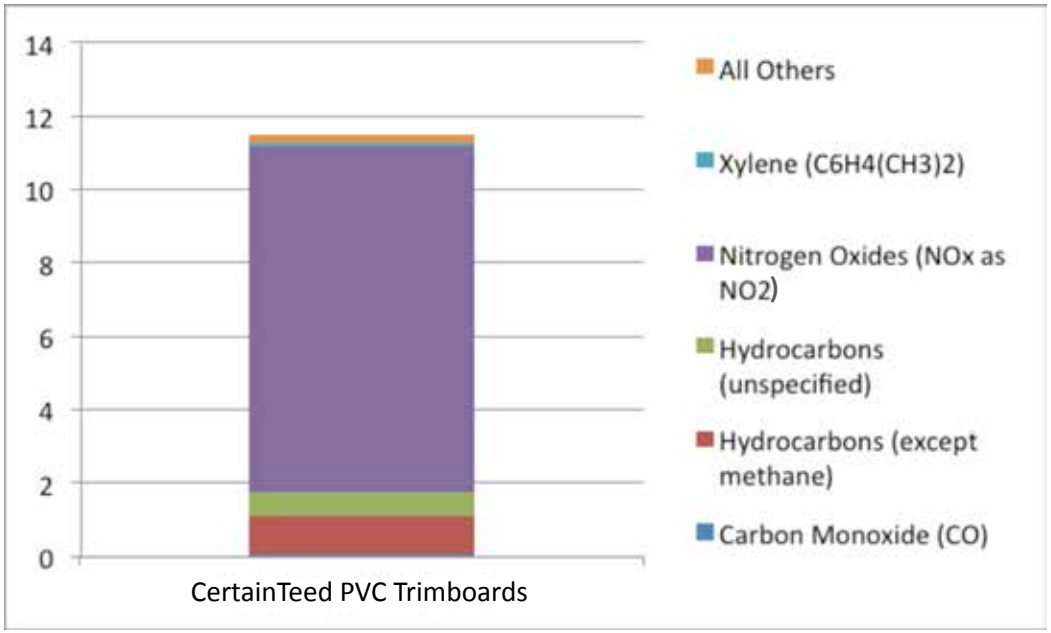
Smog Potential

Under certain climatic conditions, air emissions from industry and transportation can be trapped at ground level where, in the presence of sunlight, they produce photochemical smog, a symptom of photochemical ozone creation potential (POCP). While ozone is not emitted directly, it is a product of interactions of volatile organic compounds (VOCs) and nitrogen oxides (NOx). The Smog indicator is expressed as a mass of equivalent NOx.

Table 14. Smog Potential (g NOx eq)

Category	CertainTeed PVC Trimboard
Carbon Monoxide	0.0672
Hydrocarbons (except methane)	1.0471
Hydrocarbons (unspecified)	0.6307
Nitrogen Oxides	9.4169
Xylene	0.0883
All Others	0.2623
Sum	11.5125

Figure 15. Smog Potential (g NOx eq per ft)



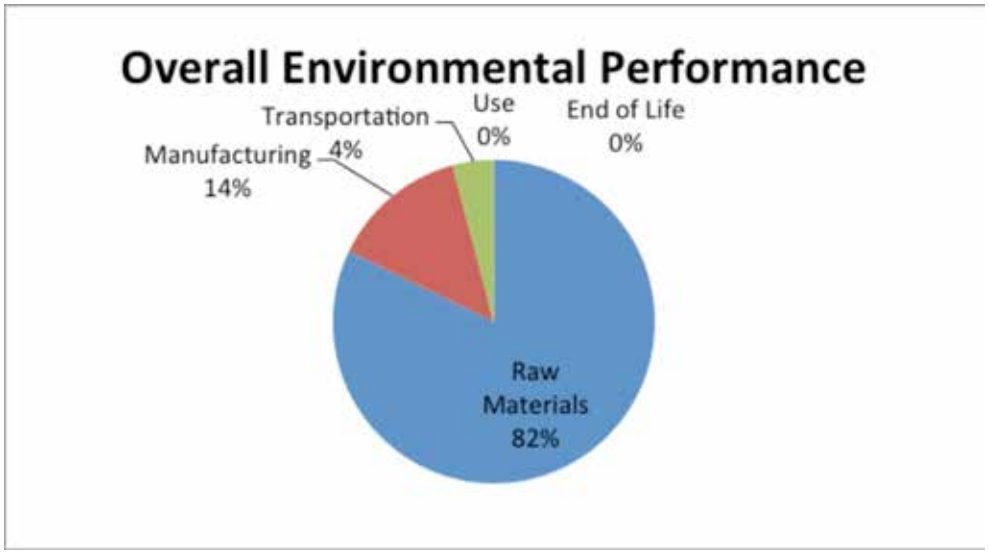
Overall Environmental Performance by Life Cycle Stage

The following graphics evaluate the overall environmental impact by life cycle stage. The life cycle stages include raw materials, manufacturing, transportation, use and end-of-life. These graphics allow the user to understand where impacts are occurring during the life cycle.

Table 15. Overall Environmental Performance by Life Cycle Stage

Category	CertainTeed PVC Trimboard
1. Raw Materials	0.0060
2. Manufacturing	0.0010
3. Transportation	0.0003
4. Use	0.0000
5. End of Life	0.0000
Sum	0.0073

Figure 16. Overall Environmental Performance by Life Cycle Stage



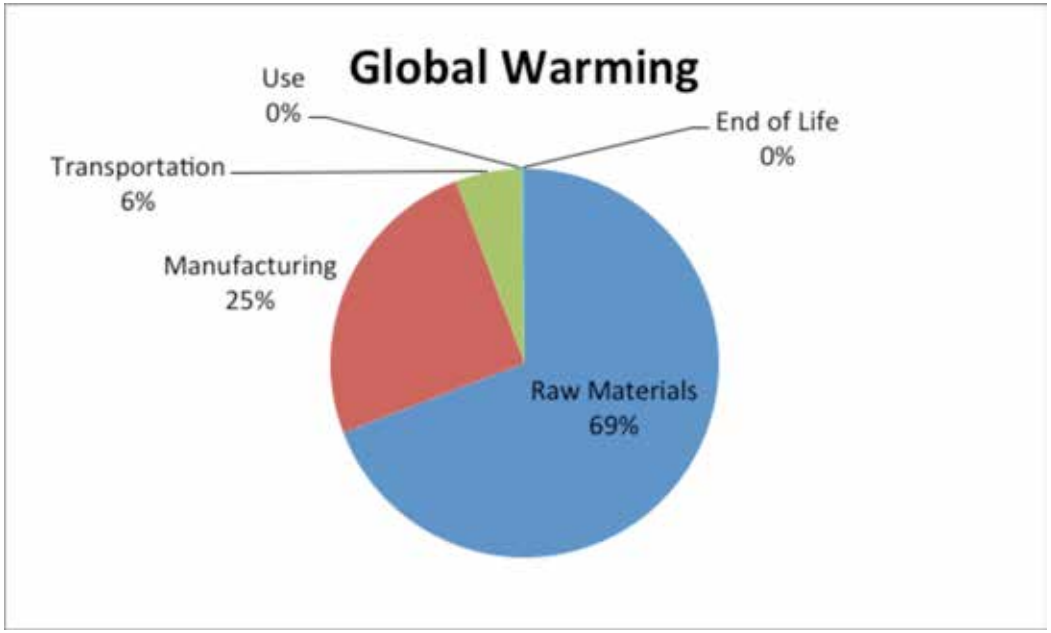
Global Warming by Life Cycle Stage

The following graphics evaluate the overall global warming impacts by life cycle stage. The life cycle stages include raw materials, manufacturing, transportation, use and end-of-life. These graphics allow the user to understand where impacts are occurring during the life cycle.

Table 16. Global Warming by Life Cycle Stage

Category	CertainTeed PVC Trimboard
1. Raw Materials	1756.1801
2. Manufacturing	636.6904
3. Transportation	139.0785
4. Use	0.4063
5. End of Life	6.3733
Sum	2538.7286

Figure 17. Global Warming by Life Cycle Stage



Recycled PVC has Lower Impacts than Virgin PVC

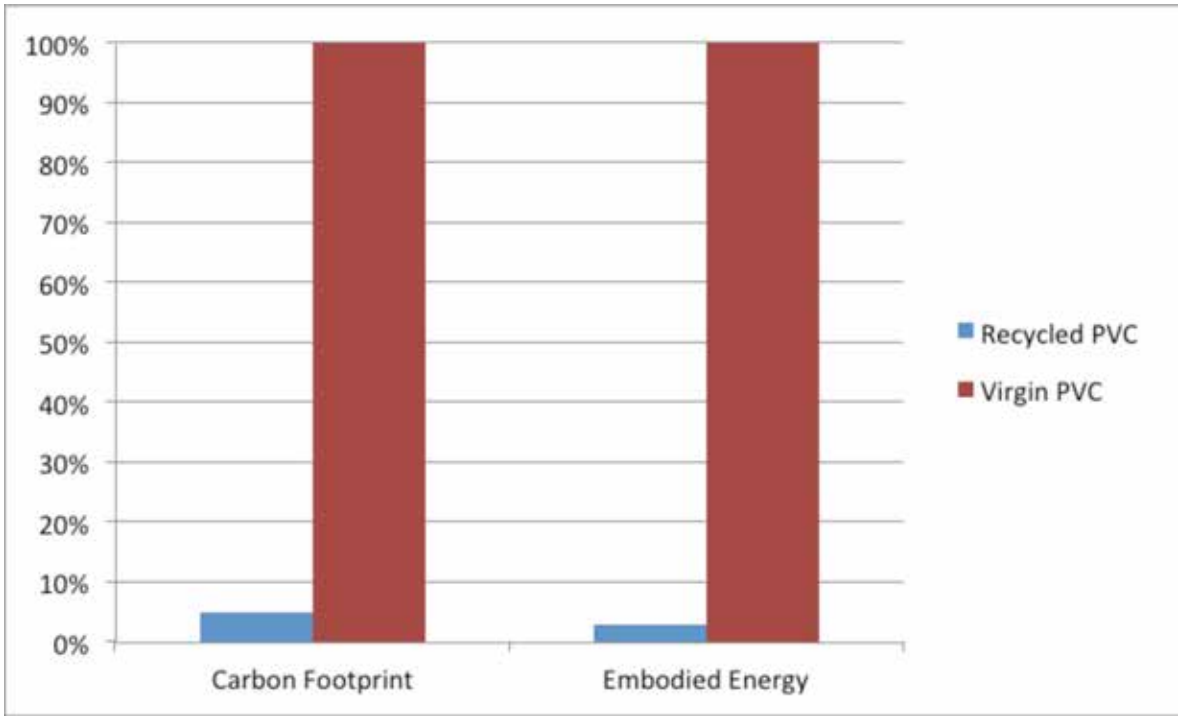
CertainTeed is proud to offer siding and trim products with recycled PVC content. By incorporating recycled PVC, less nonrenewable fossil resources will be extracted from the earth. The following data and graphics are presented to illustrate the significant benefit of using recycled content in our CertainTeed PVC Trimboards. These benefits are inherently included in the BEES results shown above, and this section goes beyond BEES to show why using recycled content is an important part of reducing the environmental impacts of CertainTeed PVC Trimboards.

Table 17. Carbon Footprint and Embodied Energy of Virgin and Recycled PVC material

	Virgin PVC	Recycled PVC
Carbon Footprint (kg CO2 /kg)	2.2	0.1
Embodied Energy (MJ/kg)	49	1.5

When conducting the LCA for CertainTeed PVC Trimboards, the supplier of the recycled PVC material supplied directly measured data showing how much energy is required to grind and process the recycled PVC material – this is the source of the recycled PVC data shown. The data for the virgin PVC were obtained from the US Life Cycle Inventory database developed by the National Renewable Energy Laboratory (NREL). The data show that recycled PVC has 97% less embodied energy and 95% less carbon footprint than virgin PVC resin. Note this data is for one kilogram of raw material, not of finished product.

Figure 18. Carbon Footprint and Embodied Energy of Virgin and Recycled PVC material

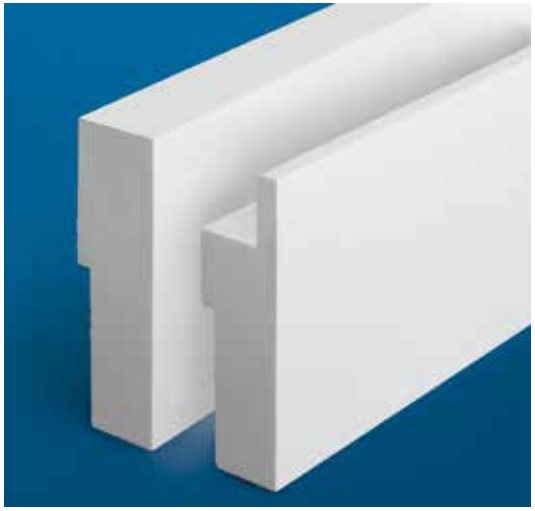


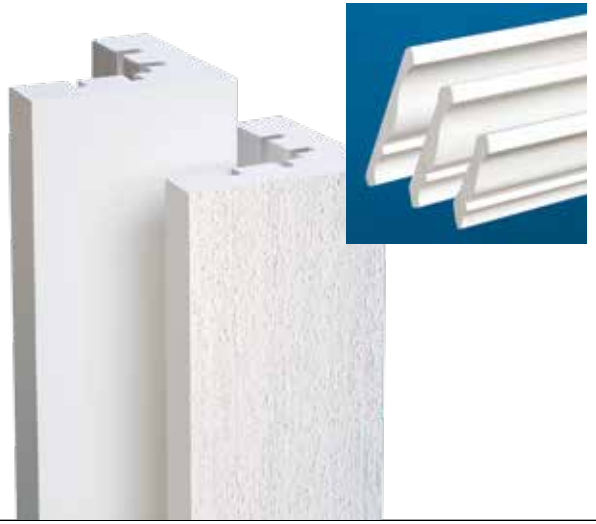
CertainTeed strives to continue increasing the amount of recycled content in its trimboard products. By using recycled PVC while maintaining the same durability and quality characteristics, CertainTeed PVC Trimboards are less impactful on our environment and more sustainable compared to the same trimboard made from virgin PVC. The recycled content certification is verified by GreenCircle Certified for our trimboard products. This certification transparently shows CertainTeed's commitment to sustainable product development and material conservation. CertainTeed PVC Trimboard is a great choice for the customer and the planet!

Conclusions

CertainTeed PVC Trimboards

- The building industry and consumers are driving demand for greener products and expect companies to transparently disclose environmental and human health information about their products. CertainTeed conducted this LCA as part of our product stewardship efforts and is proud to lead the trimboard industry in product transparency.
- Growing recognition of LCA-based data in green building rating systems such as Leadership in Energy & Environmental Design (LEED) and the National Green Building Standard (NGBS) reinforce the need to use LCA as an input for selecting environmentally preferable products.
- Using recycled content in the Restoration Millwork PVC trimboards significantly reduces the need to extract virgin resources from the earth and results in lower environmental impacts of the product. CertainTeed strives to continue to increase the use of recycled content as it becomes more available in the market.
- The majority of the environmental impact of CertainTeed PVC Trimboards comes from raw material extraction and processing, before the materials arrive at the Social Circle plant. CertainTeed is committed to working with suppliers to continue increasing efficiency and reducing impacts from the processing of raw materials.
- The Social Circle manufacturing operations represent 25% of the product carbon footprint. CertainTeed strives to set and achieve energy reduction goals in all plants, including Social Circle, to reduce the environmental impact from our facilities.





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