

Environmental Product Declaration

Typical (5/8" Type X) North American Gypsum Boards

Product Description

Type III environmental product declaration (EPD) developed according to ISO 14025 and 21930 for average 5/8" type X gypsum boards, also known as drywall, manufactured by the members of the Gypsum Association.

Declaration number: FPI/GA/01/2014

Issued April 2014

Valid until May 2019

Extension period 1 year (May 2020)



Product Description

Gypsum board is produced primarily for use as an interior surfacing for both residential and commercial building applications. 5/8" type X gypsum board is used in single-layer and double-layer wall systems, and has an assumed service life (ASL) of 60 years. Its greater thickness and special core additives provides additional fire resistance, higher rigidity, and enhanced sound attenuation as compared to regular 1/2" gypsum board. 5/8" (16mm) type X North American gypsum boards are manufactured to ASTM C1396, Standard Specification for Gypsum Board.

Product formulation (wet value at the time of manufacture), on the basis of 1,000 square feet (1 MSF or 92.9m²) of 5/8" (16mm) type X gypsum board output (dry value) with a finished density of 2.22 lbs. per sq. ft. (10.93kg per m²) at 3.3% moisture content at the facility gate:

- **Gypsum material:** 2,1176.6 lbs (960.52 kg).
- **Natural gypsum ore:** 858 lbs (389.18 kg).
- **FGD (flue gas desulfurization) synthetic gypsum:** 1,218.4 lbs (552.65 kg).
- **Post-consumer gypsum:** 41,2 lbs (18.69 kg).
- **Gypsum paper (both facing and backing):** 84.6 lbs (38.37 kg).
- **Additives:** 1,348.6 lbs (611,71 kg) Starch, vermiculite, fiberglass, dispersant, retarder, potassium sulfate, dextrose, clay (kaolin), boric acid, land plaster, foaming agent (soap), BM accelerator, ammonium sulfate, edge paste, shredded paper and water. Additives vary among manufacturers.

Scope: Cradle-to-gate.

Declared unit: 1,000 square feet (1 MSF) of 5/8" type X gypsum board at facility gate.



Packaging type and material

Packaging consists of gypsum board end tape (bundling tape) constructed of paper and containing water- and oil-based ink; plastic shrink-wrap, banding, rail bags and slip sheets; cardboard and metal edge/corner protectors; risers/spacers constructed of gypsum board; and adhesive for risers/spacers.

Table 1: Technical data summary for 5/8" type X gypsum board

Technical data	Test Method/Data Source Value/ and Units/Test Results/Statement	Specification
"R" factor – thermal resistance	ASHRAE Handbook of Fundamentals	No published requirement
Material Safety Data Sheet	Refer to Gypsum Association member company web sites	Gypsum Association member company web sites
Mold resistance	ASTM D3273	No published requirement
Water absorption	ASTM C473	ASTM C1396
Surface water absorption	ASTM C473	ASTM C1396
Surface burning characteristics	ASTM E84	ASTM C1396
Flame spread	ASTM E119	ASTM C1396
Smoke developed	ASTM E119	ASTM C1396
Foil application	No test method	ASTM C1396
Total recycled content (%)	Varies by manufacturer	As defined in ISO 14021
Pre-consumer (%)	Varies by manufacturer	
Post-consumer (%)	Varies by manufacturer	

Environment and Health During Manufacturing

The following environmental abatement pollution equipment were installed at the surveyed plants to control particulate matter (PM) emissions:

- Fabric Filter – high temperature and low temperature baghouses
- Bin Vents
- Drum Filter
- Dry Filter
- Cartridge Filters
- Precipitator
- Water Sprinklers for Dust Control

Environmental Management Systems

Environmental management systems vary by plant based on geography, local regulations, company practices and other factors.

Life Cycle Assessment

Life cycle assessment (LCA) is a rigorous study of inputs and outputs over the entire life of a product or process and the associated environmental impact of those flows to and from nature.

The underlying LCA supporting this EPD relied on two LCA data sources: 1. primary life cycle inventory (LCI) data gathered for the three inter-connected primary processes: upstream natural or crude gypsum ore extraction, paper (facing and backing) production processes and downstream gypsum board manufacturing, and 2. secondary data from commercially available LCI databases, specifically the US LCI and the US adjusted European ecoinvent v.2.2 LCI database (“US-EI”) for synthetic FGD (flue gas desulfurization) gypsum, additives, packaging and ancillary - or process - materials, such as the production of chemical inputs, fuels, electricity, etc.

See Figure 1. The system boundary includes all the production steps from extraction of raw materials from the earth (the cradle) through to final gypsum board product at the facility gate (the gate) where the product is packed and ready for shipment. Table 2 shows all included and excluded processes. The boundary includes the transportation of major inputs to, and within, each process.

Ancillary materials such as hydraulic fluids, lubricants and packaging are included in the boundary. Fixed capital equipment and human activities, such as hygiene related water use, transportation of employees, etc., are excluded.

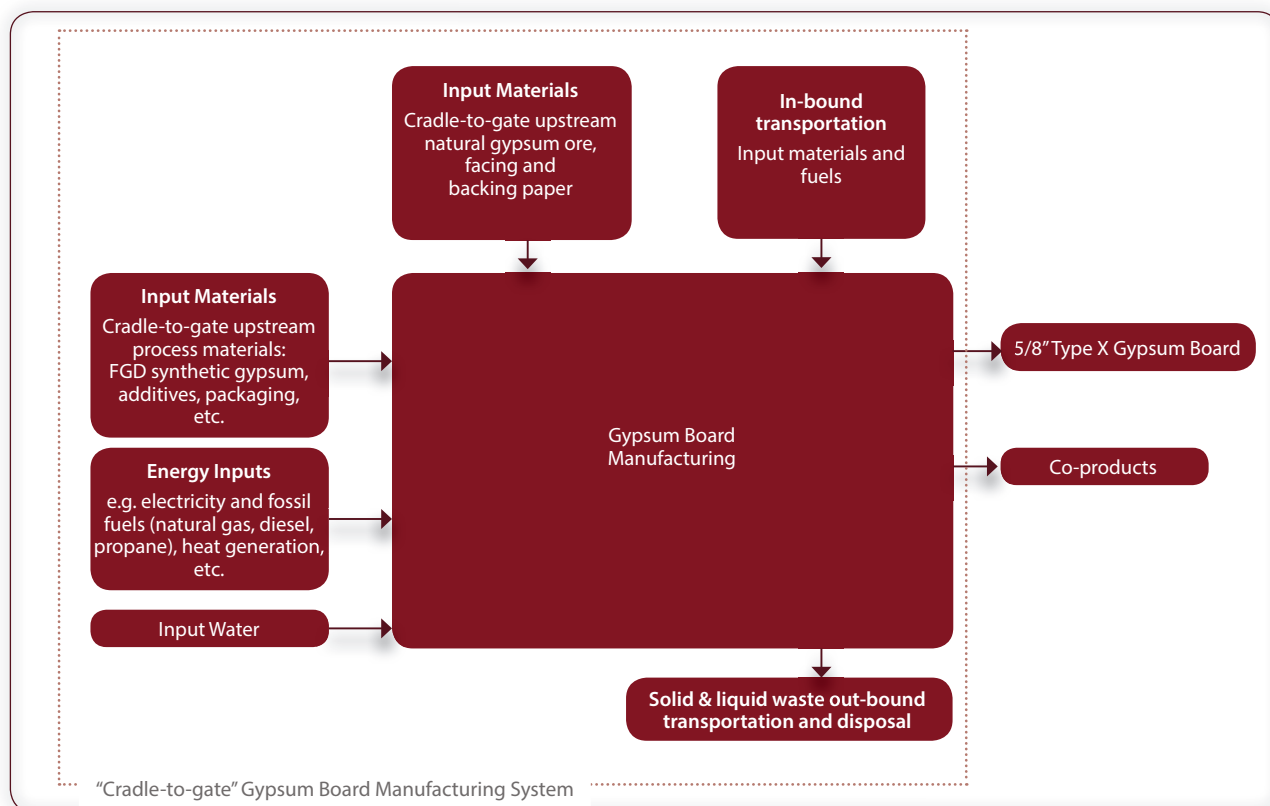
System boundary: *Life cycle activities from resource extraction through (gypsum) board product manufacture.*

Table 2: Included and Excluded Processes

"Cradle-to-Gate" system boundary	
Included	Excluded
• Input raw materials • Input process ancillary materials • Input energy supply • Operation of primary production and pollution abatement equipment • Operation of mobile support equipment • Input water (for process and cooling) • On-site recycling of post-consumer gypsum board waste • Packaging of products • In-bound transportation of raw materials, ancillary materials, intermediate products and fuels • Overhead (heating, lighting) of manufacturing facilities • Out-bound transportation and disposal of generated waste	• Fixed capital equipment • Hygiene related water use • Transportation of employees • Office heating, ventilation, air conditioning and lighting

Geographic coverage: *North America.*

Figure 1: System Boundary and Process Flows



LCA – Calculation Rules

Declared unit: 1,000 square feet at facility gate.

5/8" Type X Gypsum Board	Value and unit
Declared unit	1,000 sf
Conversion factor to kg	1,000 sf = 1,007 kg

Allocation rules

In a production process where more than one product is generated, it is necessary to allocate the environmental impacts from manufacturing in some proportional manner to the main product and co-products. The main inputs to gypsum board manufacture are gypsum (i.e., gypsum comes from quarry production, FGD synthetic gypsum and post-consumer gypsum material) and gypsum paper for facing.

When combined the noted inputs produce a main product. The rules applied to determine the allocation of environmental impacts are:

Quarry production system – On mass basis, quarry production produces 97% of quarried gypsum (main product) and 3% of solid rock (co-product). Physical allocation based on mass was applied to split the environmental load between the two products.

FGD synthetic gypsum – FGD synthetic gypsum is a co-product of coal-fired power plant generation. System expansion was applied to separate out the environmental burden associated with synthetic gypsum.

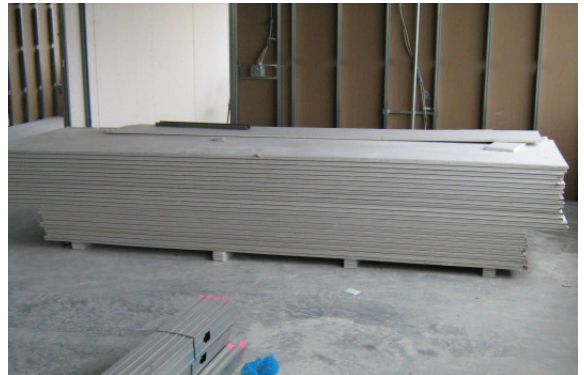
Post-consumer gypsum material – Post-consumer gypsum material collected from construction is not always fully recycled; part of it is regarded as waste. The environmental burden associated with the recycled gypsum input was calculated by debiting gypsum board production for intermittent treatment (i.e., collection, transportation and plant specific processing) of the post-consumer gypsum material and credited for the avoided post-consumer gypsum waste disposal and transportation to landfill (in other words, the LCA system expansion rules were applied).

Gypsum paper production system – On mass basis, gypsum paper manufacturing produces 97% of gypsum paper (main product) and 3% of downgraded and side-rolls (co-product). Physical allocation based on mass was applied to split the total environmental load between the two products.

Gypsum board – Gypsum board manufacturing is a complex product system with a range of input materials and variety of gypsum product outputs. Mass based physical allocation was applied to split the environmental burden among the gypsum products produced in this system.

Cut-off criteria

Mass or energy flows are excluded if they account for less than 1% of model flows and less than 2% of life cycle impacts in all categories.



LCA Results

The U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and other Environmental Impacts) life cycle impact assessment methodology (version 2.1) is applied to calculate environmental performance of gypsum board. Per declared unit impact indicator results, energy and material resource consumption, and waste are presented in Table 3. Impact indicators used are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential.

Table 3: LCA results – environmental performance of typical 5/8” type X gypsum board

Part 1- Description of the system boundary (X: included in LCA; MND: module not declared)																
Product stage			Construction process stage		Use stage								End-of-life stage			
Raw material supply	Transport	Manufacturing	Transport	Construction- Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste Processing	Disposal	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	
x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Part 2- Results of the LCA- ENVIRONMENTAL IMPACT per 1,000 sq. ft of gypsum board, with 5/8” thickness																
Parameter					Units			Total of the Product stage (A1 - A3)								
Global warming potential					kg CO ₂ -Eq.			317.4								
Depletion potential of the stratospheric ozone layer					kg CFC-11 Eq.			1.9E-05								
Acidification potential					kg SO ₂ Eq.			2.46								
Eutrophication potential					kg N Eq.			0.37								
Smog potential					kg O ₃ Eq.			12.41								
Abiotic Depletion potential-fossil fuels					MJ			596.1								

Part 3- Results of the LCA- RESOURCE USE per 1,000 sq. ft of gypsum board, with 5/8” thickness																
Parameter					Units			Total of the Product stage (A1 - A3)								
Use of non-renewable primary energy resources (NRPE)- excluding NRPE used as raw materials					MJ, HHV			5,291								
NRPE, fossil					MJ, HHV			5,048								
NRPE, nuclear					MJ, HHV			243								
Use of NRPE used as raw materials					MJ, HHV			0								
Use of non-renewable secondary fuels					MJ, HHV			0								
Use of non-renewable material resources					kg			429								
Use of renewable primary energy resources (RPE)-excluding RPE used as raw materials					MJ, HHV			154								
Use of RPE used as raw materials					MJ, HHV			0								
Use of renewable secondary fuels					MJ, HHV			0								
Use of renewable material resources					kg			0.81								
Use of secondary material					kg			571								
Net use of fresh water					m ³			3.89								

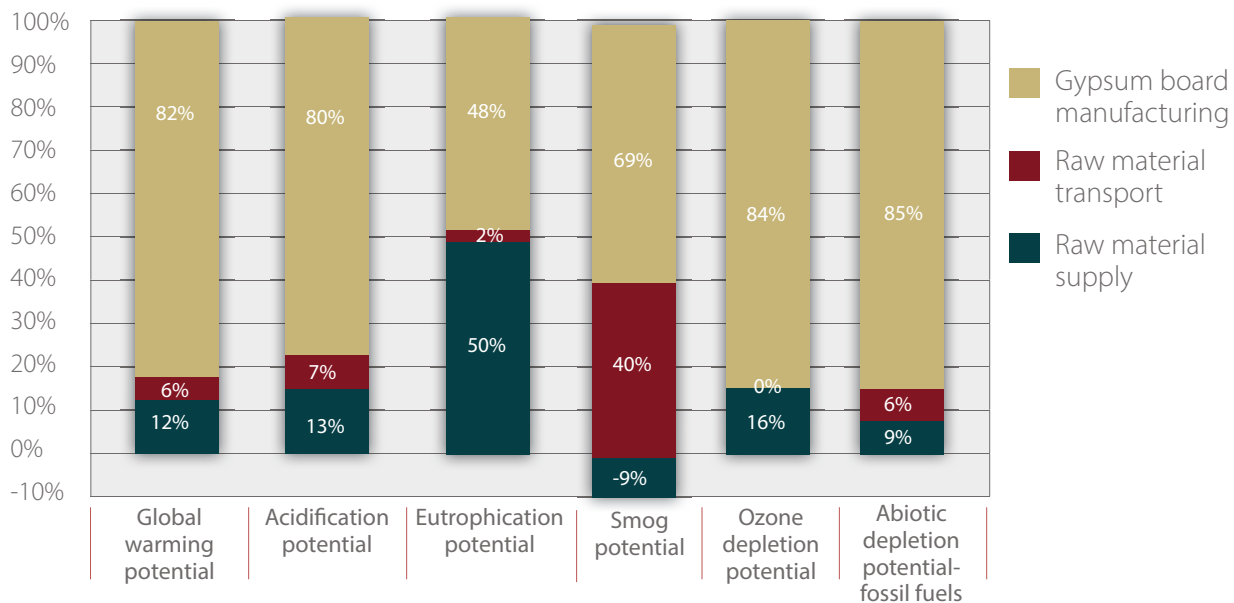
Part 4- Results of the LCA- OUTPUT FLOWS and WASTE CATEGORIES per 1,000 sq. ft of gypsum board, with 5/8” thickness																
Parameter					Units			Total of the Product stage (A1 - A3)								
Hazardous waste disposal					kg			5.25E-03								
Non-hazardous waste disposal					kg			1.94E+00								
Radioactive waste disposal					kg			0								

Note: HHV – Higher Heating Value

Interpretation

Figure 2 shows the relative contributions from the upstream raw material input supply, input transport to a manufacturing facility and gypsum board manufacturing, showing their dominance in the impact categories.

Figure 2: Relative contributions of the raw material inputs production and gypsum board manufacturing process



Note: The net impact of FGD synthetic gypsum use resulted in net benefit to the environment due to its diversion from landfilling.

Glossary

Primary Energy Consumption

Primary energy is the total energy consumed by a process including energy production and delivery losses. Energy is reported in megajoules (MJ).

Abiotic Depletion Potential – fossil fuels

This refers to potential to lead to the reduction of the availability of energy fossil fuel supplies. Fossil fuel depletion is reported in megajoules (MJ).

Global Warming Potential

This impact category refers to the potential change in the earth's climate due to accumulation of greenhouse gases and subsequent trapping of heat from reflected sunlight that would otherwise have passed out of the earth's atmosphere. Greenhouse gas refers to several different gases including carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). For global warming potential, these gas emissions are tracked and their potencies reported in terms of equivalent units of CO₂.

Acidification Potential

Acidification refers to processes that increase the acidity of water and soil systems as measured by hydrogen ion concentrations (H^+) and are often manifested as acid rain. Damage to plant and animal ecosystems can result, as well as corrosive effects on buildings, monuments and historical artifacts. Atmospheric emissions of nitrogen oxides (NO_x) and sulphur dioxide (SO_2) are the main agents affecting these processes. Acidification potential is reported in terms of SO_2 equivalent.

Eutrophication Potential

Eutrophication is the fertilization of surface waters by nutrients that were previously scarce, leading to a proliferation of aquatic photosynthetic plant life which may then lead to further consequences including foul odor or taste, loss of aquatic life, or production of toxins. Eutrophication is caused by excessive emissions to water of phosphorus (P) and nitrogen (N). This impact category is reported in units of N equivalent.

Smog Potential

Photochemical smog is the chemical reaction of sunlight, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the atmosphere. Ground-level ozone is an indicator, and NO_x emissions are a key driver in the creation of ground-level ozone. This impact indicator is reported in units of O_3 equivalent.

Ozone Depletion Potential

This impact category addresses the reduction of protective ozone within the atmosphere caused by emissions of ozone-depleting substances such as chlorofluorocarbons (CFCs). Reduction in ozone in the stratosphere leads to increased ultraviolet-B radiation reaching earth, which can have human health impacts as well as damage crops, materials and marine life. Ozone depletion potential is reported in units of equivalent CFC-11.

Source: Bare et al, 2003

References

- ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
<http://www.astm.org/Standards/C473.htm>
- ASTM C1396 / C1396M - 09a- Standard Specification for Gypsum Board.
<http://www.astm.org/Standards/C1396.htm>
- ASTM D3273-12 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
<http://www.astm.org/Standards/D3273.htm>
- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
<http://www.astm.org/Standards/E84.htm>
- ASTM E119 - 10b- Standard Test Methods for Fire Tests of Building Construction and Materials.
<http://www.astm.org/Standards/E119.htm>
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- Bushi, L. and Meil, J., 2011. A Cradle-to-Gate Life Cycle Assessment of 1/2" Regular and 5/8" Type X Gypsum Wallboard. Prepared for the Gypsum Association by Athena Sustainable Materials Institute, Ottawa.
- EN 15804:2012, Sustainability of construction works- Environmental product declarations- Core rules for the product category of construction products.
- FPIinnovations, 2013. Product Category Rules for North American Gypsum Boards. Gypsum PCR-2013: v1 PCR developed in accordance with FPIinnovations General Program Instructions.
- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations. International Standards Organization.
- ISO 21930:2007. Environmental labels and declarations – Sustainability in building construction. Environmental declaration of building products. International Standards Organization.
- Athena Institute. 2012. *Life Cycle Assessment of Cross Laminated Timber Produced at Structurlam*, Prepared for: FPIinnovations.

About this EPD

Scope of this declaration:

This EPD is cradle-to-shipping gate and addresses products from multiple manufacturers and represents an average for the membership of the Gypsum Association (GA), a not-for-profit trade association founded to promote the use of gypsum and advance the development, growth, and general welfare of the industry on behalf of its member companies with manufacturing facilities in the United States and Canada. This average is based on the firsthand data gathered for two major upstream input manufacturing processes and downstream board production: natural or crude gypsum ore extraction (six quarries and one underground mining site), gypsum paper manufacture (three plants) and gypsum board production (all GA member companies) for the reference year 2010. This declaration does not cover construction, use and end-of-life stages.



PCR:

Product Category Rules for North American Gypsum Boards
FPInnovations – Gypsum PCR-2013: v1. Prepared by FPInnovations and available at www.fpinnovations.ca.

Program Operator:

FPInnovations
2665 East Mall
Vancouver, BC V6T 1W5
1 (604) 224-3221
www.fpinnovations.ca

EPD Owner:

Gypsum Association
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782,
1 (301) 277-8686
www.gypsum.org

Gypsum Association Members:

American Gypsum Company LLC; CGC Inc.; CertainTeed Gypsum, Inc.; CertainTeed Gypsum Canada, Inc.; Continental Building Products, Inc.; Georgia-Pacific Gypsum LLC; National Gypsum Company; PABCO® Gypsum; United States Gypsum Company

PCR Review was conducted by:

T. Gloria, Industrial Ecology Consultants

EPD Review:

Independent verification of the declaration and data, according to ISO 14025 :

Third party verifier:

Thomas P. Gloria, Ph. D.
Industrial Ecology Consultants
35 Bracebridge Rd
Newton, MA 02459-1728
1 (617) 553-4929
www.industrial-ecology.com

Internal √

External

Comparison of building products using this EPD shall be carried out only at the building level; however environmental declarations from different programs may not be comparable.

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