Georgia-Pacific Gypsum

Environmental Product Declaration

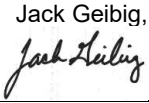
ACCORDING TO ISO 14025:2006 AND ISO 21930:2017

Type III environmental product declaration (EPD) developed according to ISO 14025:2006 and 21930:2017 for Gypsum 5/8" DensGlass® Fireguard® Sheathing



NSF Certified Environmental Product Declaration www.nsf.org

EPD Program and Program Operator Name, Address, Logo, and Website	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org
General Program Instructions and Version Number	NSF Program Operator Rules, NSF International. February 23, 2015
Manufacturer Name and Address	Georgia-Pacific Gypsum LLC 133 Peachtree St NE Atlanta, GA 30303
Declaration Number	EPD11198
Declared Product & Functional Unit	5/8” DensGlass® Fireguard® Sheathing. 92.9 m^2 (1000 ft^2) of installed product with an RSL of 75 years; Further explanatory materials may be obtained from: buildgp.com
Core standard	ISO 21930:2017
Core PCR	Smart EPD Part A Product Category Rules for Building and Construction Products and Services, Standard 1000. Version 1.2. March 14, 2025
Sub-category PCR	Smart EPD Part B Product Category Rules for Gypsum Panels. Standard 1000-004. Version 2.0. Published February 24, 2025. www.smartepd.com.
ACLCA PCR Guidance Conformance Level	Transparency
ACLCA PCR Guidance Version	Version 1.0, May 25, 2022
Product RSL Description (if Appl.)	75 years
Markets of Applicability	North America
Date of Issue	November 26, 2025
Period of Validity	11/26/2025 – 11/26/2030
EPD Type	Product-specific, manufacturer-average
Dataset Variability	N/A
EPD Scope	Cradle-to-Grave
Year(s) of reported manufacturer primary data	2023
LCA Software & Version Number	Sphera's LCA FE (fka GaBi) v10.9.0.20
LCA Generator Tool & Version Number	Sphera Gypsum Panel EPD Generator Tool v1
LCI Database(s) & Version Number	Sphera's MLC (fka GaBi) v2025.2
LCIA Methodology & Version Number	IPCC AR6, IPCC AR5, TRACI v2.2 CML v4.7

The sub-category PCR review was conducted by:	Jack Geibig (Chair), Michael Gardner, Gaurav Das
This declaration was independently verified in accordance with ISO 14025: 2006. The Smart EPD “Part A: Product Category Rules for Building and Construction Products and Services, Standard 1000. Version 1.2.(March 14, 2025), in conformance with ISO 21930:2017, serves as the core PCR ☐ INTERNAL X EXTERNAL	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com 
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera Solutions, Inc.
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com 

LIMITATIONS

EPDs are only comparable if they comply with ISO 21930, this sub-category PCR, include all relevant information modules and are based on equivalent scenarios with respect to the construction works context.

The EPD owner has sole ownership, liability, and responsibility for the EPD.

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building or construction works level, and therefore EPDs may not be used for comparability purposes when not considering the whole building life cycle. EPD comparability is only possible when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences in results upstream or downstream of the life cycle stages declared.

1 General Information

1.1 Description of Organization

Georgia-Pacific Gypsum LLC manufacturers a wide array of interior and exterior products designed to provide the highest level of performance in the most challenging commercial and residential applications. Since 1965, Georgia-Pacific has developed and manufactured high quality gypsum building products in the industry. Georgia-Pacific's versatile ToughRock® gypsum boards are ideal for interior applications, and the Dens® family of high-performance fiberglass mat-faced gypsum products offer exceptional strength and superior moisture, mold and fire resistance. Today, Georgia-Pacific is still innovating groundbreaking gypsum products designed to help construct the highest quality commercial and residential buildings.

1.2 Product Definition

Dens® panels are a family of fiberglass mat faced gypsum panels for use in new construction or renovation of residential and commercial buildings. Panels consist of a noncombustible core when tested in accordance with ASTM E136. The panel is made up of a core, primarily of gypsum, with fiberglass mat facers on the front and back of the panel. The panels are designed for direct attachment to wood and metal framing. Dens® panel products come in different widths, lengths and thicknesses and may include special facers or core additives to enhance panel performance. Dens® panels comply with ASTM C1177, ASTM C1178, or ASTM C1658 standards for gypsum panels.

1.2.1 Product Identification

5/8” DensGlass® Fireguard® Sheathing is a 0.625” (1.59 cm) thick Glass Mat Gypsum Panel and is sold in 8’ (2440 mm) to 12’ (3658 mm) length and 48” (1219 mm) width as shown in Figure-1-1.

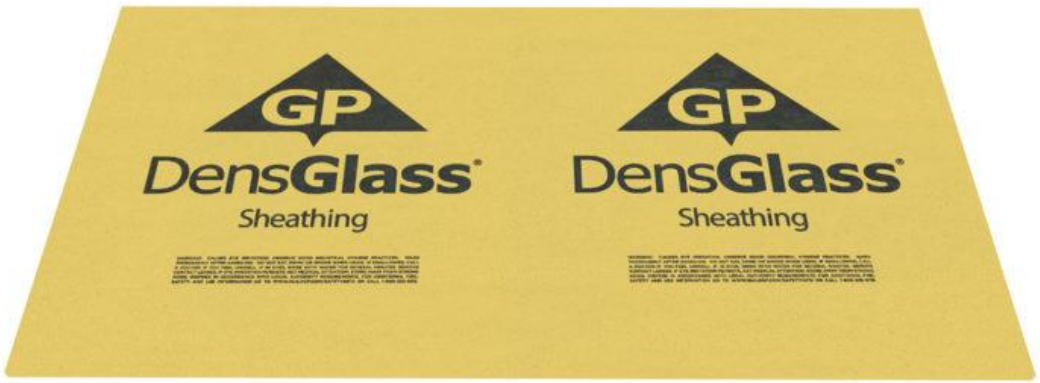


Figure 1-1: Image of 5/8” DensGlass® Fireguard® Sheathing

1.2.2 Product Specification

5/8” DensGlass® Fireguard® Sheathing complies with the standards listed in Table 1-1. Additional technical

information, installation guides, and health product declarations can be found at www.buildgp.com.

Table 1-1: Gypsum panel specification

Label	Specification	Value	
CSI/Masterformat	06 16 43	Gypsum Sheathing	
UNCPC	314	Boards and Panels	
UNSPSC	30161509	Gypsum Board	
Product class and standard	Glass Mat Gypsum Substrate for Use as Sheathing (ASTM C1177)		
Product Subcategory	Gypsum Sheathing		
Core type	Type X		
Facer type	Glass-mat		
Recycled Content	Material	Percentage of Panel By Mass	
	Recycled paper (pre-consumer)	0%	
	Recycled paper (post-consumer)	0%	
	Recycled glass	0%	
	Recycled gypsum from FDG	0%	
Options	Mold-resistant		
	Moisture-resistant		

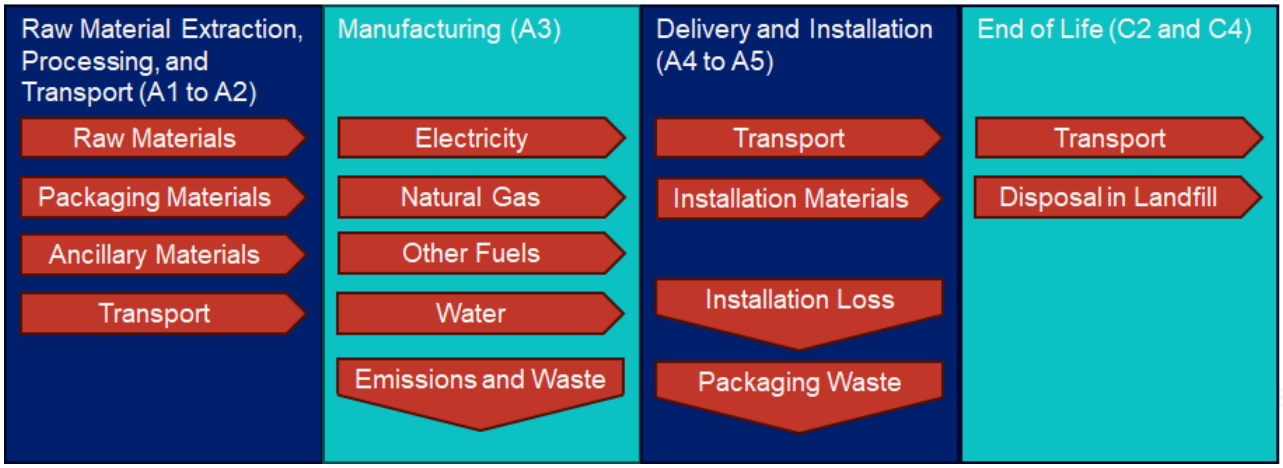


Figure 1-1: Simplified process flow diagram for 5/8” DensGlass® Fireguard® Sheathing

1.2.3 Product-Specific EPD

This EPD is based on production of 5/8” DensGlass® Fireguard® Sheathing at eight facilities across the US:

- Antioch, California
- Fletcher, Oklahoma
- Fort Dodge, Iowa
- Las Vegas, Nevada
- Lovell, Wyoming

- Newington, New Hampshire
- Savannah, Georgia
- Tacoma, Washington

The weighted average results for 5/8” DensGlass® Fireguard® Sheathing were calculated based on the 2023 annual throughput from each facility. This means that the total annual material, energy, and emission inputs and outputs from each facility were added together and divided by the total annual production in msf to generate the values used in the model. Additionally, these facilities represent 100% of the production of 5/8” DensGlass® Fireguard® Sheathing in 2023.

1.2.4 Application

5/8” DensGlass® Fireguard® Sheathing is an exterior wall substrate for various water-resistive barrier systems and attached or adhered wall cladding materials.

1.2.5 Product Specifications

5/8” DensGlass® Fireguard® Sheathing meets all relevant specifications in Table 1-2. More information can be found at www.buildgp.com.

Table 1-2: Technical Product Data

PRODUCT DATA	REQUIREMENT	REFERENCED DOCUMENTS
Width, nominal	4’ (1219 mm) ± 3/32” (2.4 mm)	ASTM C1177
Length, standard	8’, 9’, 10’ (2438, 2743, 3048 mm) ± 1/4” (6 mm)	ASTM C1177
Weight[1] nominal, lbs./sq. ft. (kg/m^2)	2.5 (12)	
Bending radius (lengthwise)	8’ (2438 mm)[2]	
Racking strength, lbs./ft. (dry) (N/m) (Ultimate – not design value)	>654 (9544)	ASTM E72
Flexural strength, parallel, lbf. (N) (4’ weak direction)	≥100 (445)	ASTM C473
Compressive strength	min. 500 psi (3445 kPa)	
Humidified deflection	<1/8” (3 mm)	ASTM C473, ASTM C1177
Permeance, perms ($ng/Pa•s•m^2$)	>17 [970]	ASTM E96
R Value, $ft^2•°F•hr/BTU$ (m^2K/W)	.67 (0.118)	ASTM C518
Combustibility	Noncombustible	ASTM E136 or CAN/ULC S114
Linear expansion with moisture change in/in/%RH (mm/mm %RH)[3]	6.25×10^{-6}	
Surface burning characteristics flame spread/smoke developed	0/0	ASTM E84 or CAN/ULC-S102
Coefficient of thermal expansion in/in/°F (mm/mm/°C)	8.5×10^{-6} (15.3×10^{-6})	ASTM E228-85

[1] Approximate weight for design and shipping. Purposes. Actual weight may vary based on manufacturing location and other factors.
[2] Double fasteners on ends as needed
[3] As stated by *Gypsum Association GA-235*

1.2.6 Material Composition

The material content for 5/8” DensGlass® Fireguard® Sheathing is shown in Table 1-3. Product formulation (wet value at the time of manufacture), on the basis of 92.9 m^2 of 5/8” DensGlass® Fireguard® Sheathing output (dry value) with a finished density of 1.18E003 kg/m^2 (242 lb/ft^2) at 0.5% moisture content at the facility gate.

This product qualifies as a manufactured article as defined by 29 CFR 1200(c) and is therefore exempt under OSHA’s Hazard Communication Standard (29 CFR 1910.1200).

Table 1-3: Material composition

INGREDIENT NAME	PERCENT COMPOSITION
Gypsum core	95.8
Paper	0
Glass mat	3.29
Additives	0.94

2 Methodological Framework

2.1 Functional Unit

Per Part B PCR section 7.1.2 (Smart EPD, 2025), the functional unit for this EPD is 92.9 m^2 (1000 ft^2) of installed product with an RSL of 75 years. Additional details are provided in Table 2-1.

Table 2-1: Functional unit properties

NAME	VALUE	UNIT
Functional Unit	92.9 (1000)	m^2 (ft^2)
Mass	1.18E003	kg
Thickness	1.59 (0.625)	cm (in.)
Reference Service Life (RSL)	75	year

2.2 System Boundary

The system boundary for this EPD is cradle to grave as shown in Table 2-2.

Table 2-2: Description of the system boundary modules

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
x	x	x	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

2.3 Allocation

Facility-level data such as air, water and soil emissions, gypsum raw material, paper raw material, water consumption and energy were allocated according to production mass. There are no co-products in the foreground system, therefore allocation was not required.

Allocation by system expansion is not applied in the background datasets. Descriptions of allocation procedures in Sphera's MLC background datasets are available online at https://lcadatabase.sphera.com/ (Sphera, 2025)

2.4 Cut-Off Rules

The requirements for the exclusion of inputs and outputs (cut-off rules) follow the guidance in Part A Section 7.1.8 (ISO 21930 Section 7.1.8). All known mass and energy flows are reported for the processes within the system boundary, and no known energy or material flows have been deliberately excluded. Use of tools for installation has been excluded, since they are used in many projects, it is difficult to determine the exact share of specific installation, and they are assumed to contribute negligibly to the results. Energy use for installation and deconstruction was excluded based on Part B PCR section 7.1.7. Any excluded flows are less than 1% of energy, mass, or environmental impacts, and the total excluded flows per module are less than 5%. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

2.5 Data Sources

The LCA model was created using the Life Cycle Assessment for Experts (LCA FE) software system for life cycle engineering, v10.9, developed by Sphera Solutions, Inc. The Managed LCA Content (MLC, 2025.2) LCI database provides the life cycle inventory data for several of the raw and process materials obtained from the background system (Sphera Solutions Inc., 2025).

Primary data for material and energy inputs associated with the production of 5/8” DensGlass® Fireguard® Sheathing were collected for each of the facilities that produce it. This primary data was provided for the twelve calendar months of 2023 except for production at the Sweetwater East facility. That data was collected for the twelve months from October 2023 to September 2024 because the Sweetwater East facility did not begin full time operations until October 2023.

Secondary data from Sphera's managed LCA content (MLC) v2025.2 was used for environmental burdens associated with raw materials and energy inputs and waste management processes as described in the

background report. Table 2-3 lists all the datasets used in the model. Additional information on these datasets can be found online at https://lcadatabase.sphera.com/ (Sphera, 2025).

Table 2-3: Data disclosure table

MATERIAL/ PROCESS CATEGORY	MODULE	MATERIAL/ PROCESS NAME	INVENTORY DATASET NAME	DATASET GEOGRAPHIC REGION	YEAR DATASET REPRESENTS	REFERENCE
Material	A1	Gypsum ore	Specific data	US	2023	-
	A1	Gypsum paper	Specific data	US	2023	-
	A1	Gypsum glass mat	Specific data	US	2023	-
Transport	A2	Single unit truck	Truck - Medium Heavy-duty Diesel Truck / 13,000 lb payload - 5	US	2023	(Sphera,2025a)
	A2	Tractor-trailer truck	Truck - Trailer, basic enclosed / 45,000 lb payload - 8b	US	2023	(Sphera,2025b)
	A2	Rail	Rail transport cargo - Diesel, average train, gross tonne weight 1,000t / 726t payload capacity	GLO	2023	(Sphera,2025c)
Energy	A3	Electricity	Electricity grid mix – SRSO	Savannah, GA	2022	(Sphera,2025e)
	A3		Electricity grid mix – SPSO	Fletcher, OK	2022	(Sphera,2025f)
	A3		Electricity grid mix – CAMX	Antioch, CA	2022	(Sphera,2025g)
	A3		Electricity grid mix – NEWE	Newington, NH	2022	(Sphera,2025h)
	A3		Electricity grid mix – MROW	Fort Dodge, IA	2022	(Sphera,2025i)
	A3		Electricity grid mix – NWPP	Lovell, WY; Las Vegas, NV; Tacoma, WA	2022	(Sphera,2025j)
	A3	Natural gas	Natural gas mix	US	2021	(Sphera,2025l)

2.6 Data Quality

A detailed description of the data collected, and the data quality requirements related to ISO 14044:2006 (ISO, 2006b) and ISO 21930:2017 (ISO, 2017) is provided in the LCA background report and is summarized here. Data quality is assessed based on its representativeness (technology coverage, geographic coverage, time coverage), precision, completeness, consistency, reproducibility, transparency, and uncertainty as shown in Table 2-4.

Table 2-4: Summary of Data Quality Assessment

METRIC	DESCRIPTION	EVALUATION
Geographic Representativeness	All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used.	Good
Technological Representativeness	All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used.	Very Good
Temporal Representativeness	All primary data were collected for the year 2023. All secondary data come from the MLC 2025.2 databases and are representative of the	Very Good

	years 2020 – 2024	
Completeness	Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. All background data are sourced from MLC 2025.2 databases with the documented completeness.	Very Good

3 Technical Information and Scenarios

3.1 Manufacturing (A1 to A3)

Crushed natural gypsum, found in sedimentary rock formations, or synthetic gypsum, FGD, is heated in a process called calcination to remove moisture. The calcined gypsum is mixed with water and additives to enhance the board's characteristics, and a slurry is formed. This slurry is fed onto a continuously moving sheet of glass mat, and another sheet is laid on top. As the board moves down the conveyer, the gypsum begins recrystallizing, and the hardened board is cut to finished length and dried to remove any free moisture. End tape is applied to some finished products, and it is packaged for shipment. Georgia-Pacific produces gypsum panels at twelve different facilities across the US and each manufacturing sites follows the same general processes as shown in Figure 3-1. The 5/8" DensGlass® Fireguard® Sheathing product does not include any recycled inputs. The raw material quantities, energy quantities, waste quantities, and inbound transport distances and modes are based on primary data. All transport includes interim transport via distribution centers and terminals, and all truck transport includes empty backhauls. Transportation details are provided in Table 3-3.

For each 1000 kg of 5/8” DensGlass® Fireguard® Sheathing, an average of 19.1 kg of gypsum are beneficially reused or recycled offsite and 53.4 kg are taken by truck an average of 44 km to be landfilled.

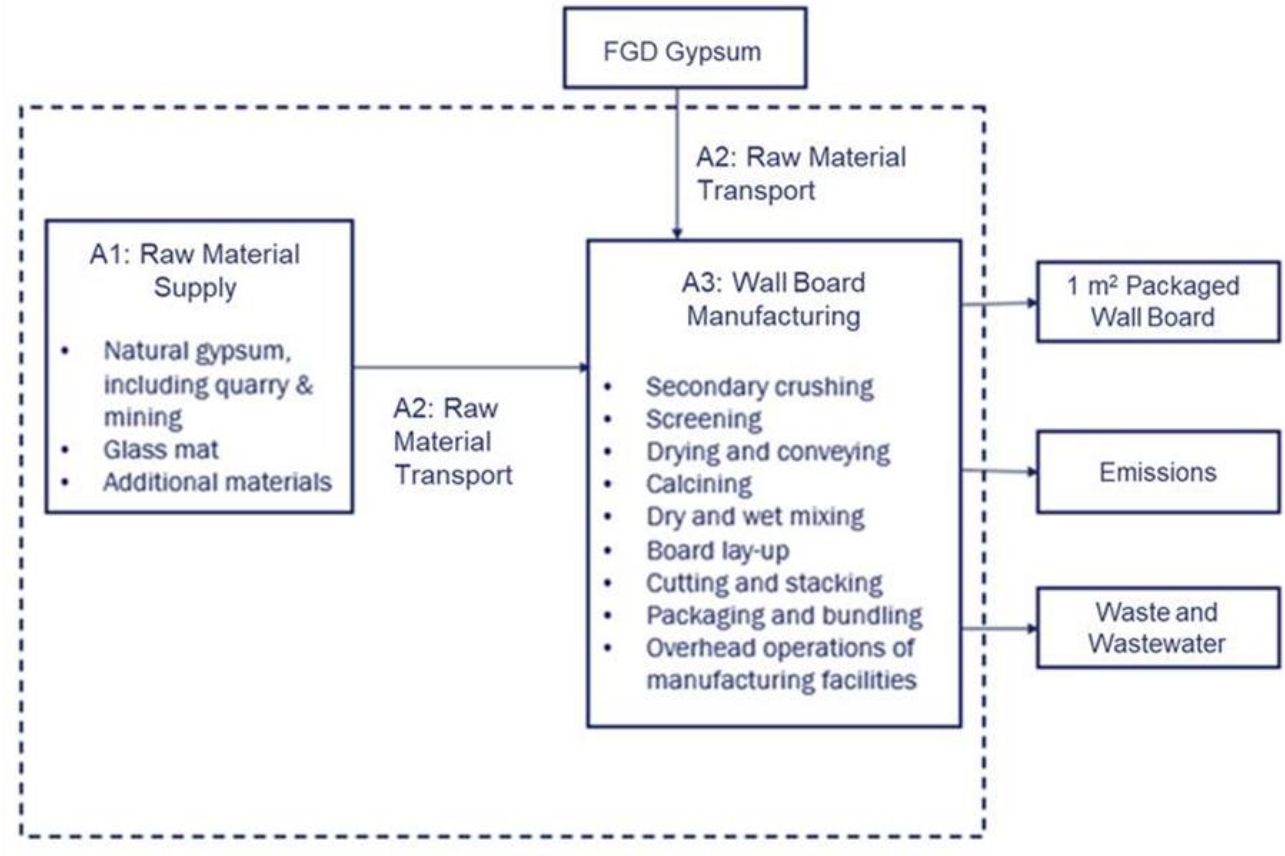


Figure 3-1: Simple flow chart providing details on the Product Stage (A1 to A3) for 5/8” DensGlass® Fireguard® Sheathing

Table 3-3: Raw material transport from suppliers to manufacturing site (A2)[a]

TRANSPORT / VEHICLE TYPE, INCL EMISSION CLASS	FUEL TYPE	FUEL EFFICIENCY, L/100KM	PAYLOAD CAPACITY (MT)	CAPACITY UTILIZATION (INCLUDING EMPTY RUNS, MASS BASED)
Tractor-trailer truck	Diesel	38.8	20.4	0.39
Rail	Diesel	212	726	0.4
Ship	HFO	16,000	52,100	0.7

a. **The distance transported varies based on supplied primary data for each material.**

3.2 Packaging

Where pallets are used to ship finished product, they are included as packing material inputs. The mass of pallets per functional unit of panel are shown in Table 3-4. Production and transport of packaging is included in module A3 and only one reuse of pallets is considered. Transport of the packaging to the installation site is

included in module A4. Packaging disposition at end-of-life is based on PCR Part B, Section 9.4.3, Table 13 (Smart EPD, 2025) and is included in module A5.

Table 3-4: Packaging composition and disposition at end-of-life

MATERIAL	MASS	UNITS	DISPOSITION AT END-OF-LIFE
Pallets	194	kg/FU	Reused once and then landfilled

3.3 Biogenic Carbon Content

The biogenic carbon content of the construction product leaving the factory gate and any accompanying packaging are declared in Table 3-5.

Table 3-5: Biogenic carbon content of product and packaging

BIOGENIC CARBON CONTENT	UNIT (KG C PER FUNCTIONAL UNIT)
Biogenic carbon content in product	0
Biogenic carbon content in accompanying packaging (including installation waste)	0.521

3.4 Transport to the Building Site (A4)

Table 3-6 shows the assumptions associated with transport of the packaged 5/8” DensGlass® Fireguard® Sheathing to the building site.

Table 3-6: Transport to the building site (A4) details

TRANSPORT / VEHICLE TYPE, INCL EMISSION CLASS	DESCRIPTION OF TRANSPORT	FUEL TYPE	FUEL EFFICIENCY, L/100KM	DISTANCE, KM	CAPACITY UTILIZATION (INCLUDING EMPTY RUNS, MASS BASED)	WEIGHT OF PRODUCTS TRANSPORTED, KG
Tractor-trailer truck	From manufacturing site to DC	Diesel	38.8	448	0.78	1.18E003
Rail	From manufacturing site to DC	Diesel	212	208	0.4	1.18E003
Single unit truck	From DC to construction site	Diesel	23.3	40	0.38 considering empty backhaul	1.18E003

3.5 Product Installation (A5)

The installation of panels involves measuring and cutting them to size. The panel installation is done manually.

The process considers 10% material loss as mentioned in the PCR Part B section 7.1.7.3.2 (Smart EPD, 2025). Additionally, electricity use from power tools such as reciprocating saws or track saws will contribute negligible to the overall impacts. Ancillary materials required for installation include fasteners, joint tape, and joint compound. Joint compounds and tape are applicable only in interior settings. Since 5/8” DensGlass® Fireguard® Sheathing is primarily used as an exterior substrate panel, joint compounds and tape are not required for its installation.

This installation scrap is accounted in the A5 module along with the packaging waste generated during the installation. The packaging waste is assumed to be landfilled based on PCR part B (Smart EPD, 2025).

Table 3-7: Installation scenario

NAME	VALUE	QUANTITY PER FU
Installation scrap rate	10	%
Lightweight Ready Mixed (interior applications only)	0	kg
Conventional Ready Mixed (interior applications only)	0	kg
Joint tape (370 feet per FU) (interior applications only)	0	kg
Screws (1,250 per FU) (all applications)	2.70	kg
Ancillary products (state)	0	kg
Net freshwater consumption specified by water source and fate (e.g., X m3 river water evaporated, X m3 city water disposed to sewer)	0	m^3
Electricity consumption	0	kWh
Other energy carriers	0	MJ
Product loss per functional unit	118	kg
Total packaging waste materials resulting from on-site waste processing (default assumption: sent to landfill)	0.948	kg
Plastics	0	kg
Metals	0	kg
Pulp	0	kg
Total waste materials resulting from on-site waste processing (sum of product loss and packaging waste) (default assumption: sent to landfill)	119	kg
Biogenic carbon contained in packaging (including installation waste)	1.9	kg CO_2

3.5.1 Reference Service Life

The default RSL of 75 years provided by the Part B PCR section 7.1.4Smart EPD, 2025) is used in this EPD.

3.6 Use (B1-B7)

Gypsum panels are assumed to have no use stage impact, based on PCR Part B section 7.1.7.4 (Smart EPD, 2025).

Table 3-8: RSL details

REQUIREMENT	VALUE
RSL	75 years
Declared product properties (at the gate) and finishes, etc.	As described in Table 1-2
Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes)	Gypsum panels should be stored, handled, and installed in accordance with GP's storage, handling and installation instructions (available at www.buildgp.com), standard building practices and all applicable building codes.
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Storage, handling, installation, and finishing recommendations can be found in GP Gypsum installation documentation at www.buildgp.com.
Outdoor environment, (if relevant for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	Gypsum panels are manufactured for a variety of applications. Select panels with characteristics appropriate to the conditions of the application.
Use conditions, e.g. frequency of use, mechanical exposure.	Gypsum panels are used continuously throughout their lifetime, and as a non-structural component they are not intended to be exposed to significant mechanical stress.
Maintenance, e.g. required frequency, type and quality of replacement components	No general maintenance is required. If damaged while in service, repair or replacement is recommended. Repair or replacement panels should be the same type, classification, and thickness as the original components.

3.7 End-of-life

After manual deconstruction, the product is collected with mixed construction waste and transported 161 km to a landfill and disposed (Table 3-9).

Table 3-9: End-of-Life (C1-C4)

NAME		VALUE		QUANTITY PER FU
Demolition (module C1)		0		kwh
		Mass percent	Distance	
Transport (module C2)	Truck	74.6%	44	km
	Rail	25.4%	469	km
Collection process (specified by type)	Collected with mixed construction waste	0		kg
	Landfill	1.18E003		kg
	Recycling/Reuse	0		kg
Disposal (specified by type)	Product or material for final disposal	1.18E003		kg
Removals of biogenic carbon (excluding packaging)		0		kg CO_2

4 Environmental Indicators Derived from LCA

The impact categories and methodologies required by the Part A PCR section 7.3 (Smart EPD, 2025) were used. The life cycle impact assessment (LCIA) used IPCC AR4 (IPCC, 2007), IPCC AR5 (IPCC, 2014) and AR6 (IPCC, 2023) for global warming, TRACI v2.2 (US EPA, 2024) for acidification, eutrophication, ozone depletion, and smog formation, and CML v4.7 (CML, 2016) was used for abiotic resource depletion, fossil. LCIA results are shown by module in Table 4-1. These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The system boundary for this EPD is cradle to grave. Modules not reported in the tables below are included within the system boundary but are assumed to have no environmental impact, including Module B (use stage), Module C1 (deconstruction), and Module C3 (waste processing). Deconstruction is assumed to be manual, resulting in no impacts for Module C1. At end-of-life, all gypsum is landfilled without additional processing, resulting in no impacts for Module C3.

Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building or construction works has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase only when product or construction works performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930 or EN 15804. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparisons can be inaccurate and could lead to erroneous selection of materials or products that are higher-impact, at least in some impact categories.

Table 4-1: LCIA results for 5/8” DensGlass® Fireguard® Sheathing

Indicator	A1 to A3	A4	A5	C2	C4
IPCC AR6 - Total [kg CO2 eq.]	5.04E+02	6.31E+01	7.78E+01	2.29E+01	1.81E+01
IPCC AR6 - Biogenic [kg CO2 eq.]	1.77E+00	2.99E-01	1.13E+00	1.21E-01	-5.85E-02
IPCC AR6 - Fossil [kg CO2 eq.]	5.02E+02	6.28E+01	7.66E+01	2.27E+01	1.80E+01
IPCC AR6 - LUC [kg CO2 eq.]	4.72E-01	3.32E-02	6.82E-02	1.20E-02	7.40E-02
IPCC AR5 - Total [kg CO2 eq.]	5.20E+02	6.41E+01	7.98E+01	2.32E+01	1.84E+01
IPCC AR5 - Biogenic [kg CO2 eq.]	1.91E+00	3.04E-01	1.29E+00	1.23E-01	-4.79E-02
IPCC AR5 - Fossil [kg CO2 eq.]	5.18E+02	6.38E+01	7.84E+01	2.31E+01	1.84E+01
IPCC AR5 - LUC [kg CO2 eq.]	4.73E-01	3.32E-02	6.83E-02	1.20E-02	7.40E-02
IPCC AR4 - Total [kg CO2 eq.]	4.94E+02	6.24E+01	7.64E+01	2.26E+01	1.78E+01
IPCC AR4 - Biogenic [kg CO2 eq.]	1.66E+00	2.94E-01	1.01E+00	1.19E-01	-6.66E-02
IPCC AR4 - Fossil [kg CO2 eq.]	4.92E+02	6.21E+01	7.53E+01	2.25E+01	1.78E+01
IPCC AR4 - LUC [kg CO2 eq.]	4.72E-01	3.32E-02	6.83E-02	1.20E-02	7.40E-02
Ozone Depletion Potential [kg CFC 11 eq.]	1.31E-06	1.78E-11	1.31E-07	5.63E-12	5.95E-11
Acidification Potential [kg SO2 eq.]	1.31E+00	3.05E-01	2.15E-01	8.66E-02	1.10E-01
Eutrophication - Freshwater [kg P eq.]	1.32E-03	5.12E-05	1.60E-04	1.87E-05	1.21E-05
Eutrophication - Marine [kg N eq.]	6.96E-01	2.85E-01	1.29E-01	7.97E-02	5.70E-02
Photochemical Oxidation Formation [kg O3 eq.]	2.70E+01	7.68E+00	4.50E+00	2.36E+00	2.06E+00

Resource use indicators are shown in Table 4-2. NRSF, SM, RSF, and RE are not relevant for the Dens® family of gypsum panels, and therefore the results are zero.

Table 4-2: Resource use results for 5/8” DensGlass® Fireguard® Sheathing

	A1 to A3	A4	A5	C2	C4
RPRe [MJ]	5.90E+02	3.36E+01	1.06E+02	1.19E+01	4.57E+01
RPRm [MJ]	1.39E+01	0.00E+00	1.39E+00	0.00E+00	0.00E+00
RPRT [MJ]	6.04E+02	3.36E+01	1.08E+02	1.19E+01	4.57E+01
NRPRe [MJ]	7.31E+03	8.09E+02	1.03E+03	2.93E+02	2.37E+02
NRPRm [MJ]	7.15E+01	0.00E+00	7.15E+00	0.00E+00	0.00E+00
NRPRT [MJ]	7.39E+03	8.09E+02	1.04E+03	2.93E+02	2.37E+02
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ADPfossil [MJ]	6.25E+03	8.01E+02	9.09E+02	2.90E+02	2.30E+02
FW [m3]	5.94E+00	3.63E-02	6.38E-01	1.28E-02	5.72E-02

Output and waste flows are shown in Table 4-3. HWD, CRU, MER, EEE, and EET are not relevant for the Dens® family of gypsum panels, and therefore the results are zero.

Table 4-3: Output and waste results for 5/8” DensGlass® Fireguard® Sheathing

	A1 to A3	A4	A5	C2	C4
HWD [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD [kg]	1.10E+01	0.00E+00	1.26E+02	0.00E+00	1.18E+03
HLRW [kg]	8.42E-05	3.30E-06	1.35E-05	1.07E-06	2.61E-06
ILLRW [kg]	7.16E-02	2.77E-03	1.18E-02	8.96E-04	2.51E-03
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR [kg]	2.48E+00	0.00E+00	2.48E-01	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Biogenic carbon removals and emissions are shown in Table 4-4. The only biogenic carbon removals and emissions are from packaging (i.e., BCRK and BCEK) including the packaging used for the 10% material loss during installation (A5). Therefore, all other values are zero.

Table 4-4: Output and waste results for 5/8” DensGlass® Fireguard® Sheathing

	A1 to A3	A4	A5	C2	C4
BCRP [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK [kg]	1.73E+00	0.00E+00	1.73E-01	0.00E+00	0.00E+00
BCEK [kg]	0.00E+00	0.00E+00	1.90E+00	0.00E+00	0.00E+00
BCEW [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-5 shows the variation in A1 to A3 LCIA results for 5/8” DensGlass® Fireguard® Sheathing. While the product average inputs and outputs were based on the sum total of inputs and outputs from all facilities divided by total production in msf, the weighted coefficient of variation (COV) relative to the weighted algebraic mean is reported as a measure of variation among the different facilities. The individual facility results show how the results may vary, and they provide insights into the potential uncertainty in the results. The COV for total GWP is only ~10%, but biogenic and dLUC show much larger variations due to differences in paper and wood packaging used at the different facilities. The variation in AP, EP-marine, and POCP are primarily due to differences in gypsum transport distance because some facilities receive gypsum from overseas.

Table 4-5: Range of A1 to A3 LCIA results for 5/8” DensGlass® Fireguard® Sheathing produced at different facilities

Indicator	Minimum	Weighted Mean	Maximum	Weighted COV
IPCC AR6 - Total [kg CO2 eq.]	4.04E+02	5.04E+02	5.68E+02	10%
IPCC AR6 - Biogenic [kg CO2 eq.]	-2.95E+00	1.77E+00	3.98E+00	111%
IPCC AR6 - Fossil [kg CO2 eq.]	4.00E+02	5.02E+02	5.63E+02	10%
IPCC AR6 - LUC [kg CO2 eq.]	2.35E-01	4.72E-01	1.11E+00	63%
IPCC AR5 - Total [kg CO2 eq.]	4.17E+02	5.20E+02	5.85E+02	10%

Indicator	Minimum	Weighted Mean	Maximum	Weighted COV
IPCC AR5 - Biogenic [kg CO2 eq.]	-2.84E+00	1.91E+00	4.14E+00	104%
IPCC AR5 - Fossil [kg CO2 eq.]	4.14E+02	5.18E+02	5.81E+02	10%
IPCC AR5 - LUC [kg CO2 eq.]	2.36E-01	4.73E-01	1.11E+00	63%
IPCC AR4 - Total [kg CO2 eq.]	3.95E+02	4.94E+02	5.56E+02	10%
IPCC AR4 - Biogenic [kg CO2 eq.]	-3.04E+00	1.66E+00	3.86E+00	118%
IPCC AR4 - Fossil [kg CO2 eq.]	3.92E+02	4.92E+02	5.52E+02	10%
IPCC AR4 - LUC [kg CO2 eq.]	2.35E-01	4.72E-01	1.11E+00	63%
Ozone Depletion Potential [kg CFC 11 eq.]	1.24E-06	1.31E-06	1.34E-06	3%
Acidification Potential [kg SO2 eq.]	6.25E-01	1.31E+00	1.94E+00	41%
Eutrophication - Freshwater [kg P eq.]	1.21E-03	1.32E-03	1.40E-03	5%
Eutrophication - Marine [kg N eq.]	2.22E-01	6.96E-01	1.15E+00	53%
Photochemical Oxidation Formation [kg O3 eq.]	9.76E+00	2.70E+01	4.31E+01	50%

4.1 Interpretation

The LCA study results found the manufacturing stage has the highest contribution to global warming potential. The manufacturing stage includes the gypsum wallboard production and the energy consumption for wallboard manufacturing. The raw materials supply had the highest contribution to eutrophication potential and ozone depletion potential. This stage includes the extraction and production of all raw materials used in the gypsum panel product.

5 Additional Environmental Information

5.1 Regulated Hazardous Substances

DensGlass® Fireguard® Sheathing qualifies as a manufactured article as defined by 29 CFR 1200(c) and is therefore exempt under OSHA's Hazard Communication Standard (29 CFR 1910.1200). This product contains no listed Proposition 65 chemicals known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute. Additional information on composition, safe handling and proper use of the product can be found at www.buildgp.com in the voluntary product information document and Healthy Product Declaration (HPD). Gypsum panels should be stored, handled, and installed in accordance with GP's storage, handling and installation instructions (available at www.www.buildgp.com), standard building practices and all applicable building codes.

5.2 Release of Dangerous Substances from Construction Products

GP Gypsum panels qualify as a manufactured article as defined by 29 CFR 1200(c) and are therefore exempt under OSHA's Hazard Communication Standard (29CFR 1910.1200). Additional information on composition, safe handling and proper use of the product can be found on www.buildgp.com in the voluntary information product document and Healthy Product Declaration (HPD).

5.3 Hydrogen Sulfide Formation

Disposal of gypsum drywall in landfills has been shown to elevate hydrogen sulfide (H_2S) concentrations in landfill gas, a problem with respect to odor, worker safety, and deleterious effects on gas-to-energy systems.

Hydrogen sulfide (H_2S) formation in Municipal Solid Waste (MSW) and Construction & Demolition (C&D) landfills requires a sulfate source, carbon source, anaerobic conditions, moisture, pH, and temperature.

Gypsum panels are a significant contributor to H_2S formation.

Problems and Solutions:

Issues in Landfill Gas (LFG) Projects: High H_2S concentrations in LFG can cause engine wear and corrosion, leading to more frequent maintenance. Combustion of H_2S-rich LFG emits sulfur dioxide (SO_2), a regulated pollutant with strict emission limits in the U.S.

Prevention Measures: Diverting gypsum panels from landfills can reduce H_2S formation. Some landfills ban drywall disposal, except in small amounts. Recycling markets for gypsum drywall (e.g., agricultural soil amendments, new drywall production) help reduce landfill deposits.

Additional explanatory material related to product manufacturing, sustainability practices, and technical documentation can be found at buildgp.com.

6 References

Chea Chandara, et al., Use of waste gypsum to replace natural gypsum as set retarders in portland cement, Waste Management, Volume 29, Issue 5, May 2009, Pages 1675-1679.

Sarah Hansen, Pedram Sadeghian, Recycled gypsum powder from waste drywalls combined with fly ash for partial cement replacement in concrete, Journal of Cleaner Production. Volume 274, 20 November 2020, 122785.

CML (2016). CML-IA Characterisation Factors. Retrieved April 11, 2025, from www.universiteitleiden.nl/: https://www.universiteitleiden.nl/en/research/research-output/science/cml-ia-characterisation-factors

IPCC. (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change; Core Writing Team, R.K. Pachauri and A. Reisinger (eds.). IPCC, Geneva, Switzerland, 104 pp.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. Retrieved April 11, 2025 from https://www.ipcc.ch/report/ar5/syr/

IPCC. (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change; Core Writing Team, H. Lee and J. Romero (eds.). IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647.

ISO 14025 (2006a). Environmental labels and declarations– Type III environmental declarations – Principals and procedures; International Organization for Standardization; Geneva, Switzerland. Retrieved from https://www.iso.org/standard/38131.html

ISO 14044 (2006b). Environmental management – life cycle assessment – Requirements and guidelines; International Organization for Standardization; Geneva, Switzerland. Retrieved from https://www.iso.org/standard/38498.html

ISO 21930 (2017). Sustainability in building construction – Environmental declaration of building products; International Organization for Standardization; Geneva, Switzerland. Retrieved from

https://www.iso.org/standard/61694.html

Sphera (2025). Search Life Cycle Assessment Datasets, Retrieved April 11, 2025 from Sphera.com: https://lcadatabase.sphera.com/

Sphera (2025 a). US: Truck – Medium Heavy-duty Diesel Truck / 13,000 lb payload – 5 Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/3cc7a8ab-098e-4412-9846-84b2d808636e.xml

Sphera (2025 b). US: Truck - Trailer, basic enclosed / 45,000 lb payload - 8b Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/56124bd9-200a-422a-8253-d48f69f2a63b.xml

Sphera (2025 c). GLO: Rail transport cargo - Diesel, average train, gross tonne weight 1,000t / 726t payload capacity Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/826cfd52-1529-4051-90d2-ed92a04d34ce.xml

Sphera (2025 e). US: Electricity grid mix – SRSO Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/cbb1924b-d885-475f-b46a-f838da5b41bc.xml

Sphera (2025 f). US: Electricity grid mix – SPSO Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/8c80ebc6-651c-469f-8f04-a2c496143f45.xml

Sphera (2025 g). US: Electricity grid mix – CAMX Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/1c78f928-f888-4259-9bf6-8d68be910df6.xml

Sphera (2025 h). US: Electricity grid mix – NEWE Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/da1f6059-725f-4072-b662-075e3dbe93b6.xml

Sphera (2025 i). US: Electricity grid mix – MROW Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/73277221-20ce-4028-8ca6-a0eacc1433a7.xml

Sphera (2025 j). US: Electricity grid mix – NWPP Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/337b0005-2dd9-4ccb-8941-f4df697b3a55.xml

Sphera (2025 l). US: Natural gas mix Unit process. Sphera Managed LCA Content Databases. https://lcadatabase.sphera.com/2025/xml-data/processes/90be2ca7-96eb-4949-8e6d-c60dd58018aa.xml

Smart EPD. (2025). Part A Product Category Rules For Building and Construction Products and Services, version 1.2.

Smart EPD. (2025). Part B Product Category Rules for Gypsum Panels; Version 2.

Kasra Takbiri and Pedram Sadeghian, Recycling Waste Gypsum Drywalls as Partial Cement Replacement in Concrete Exposed to Different Environmental Conditions, J*ournal of Materials in Civil Engineering* Volume 36, Issue 8.