SMART EPD®
PART B PRODUCT CATEGORY RULES FOR GYPSUM PANELS

Standard 1000-004, version 2
February 24, 2025



Version notes

Version 1.0, Published July, 2019
PCR for Gypsum Panel Products
Initial publication with NSF

Version 1e/1.1, Published October, 2019
PCR for Gypsum Panel Products
No changes provided in NSF version log

Version 1.1ext, Published November 2024, *NSF 1114-2024ext*
PCR for Gypsum Panel Products
Extension, no additional changes made

Version 2.0 – Published February 2025
Update of v1.1 to Smart EPD PCR Part B for Gypsum Panels (Standard 1000-004) products to conform with ISO 21930:2017 and Smart EPD Part A.

See table below for a summary of amendments between v1.1 and v2.

Topic	Version 1.1 (NSF, 2019)	Version 2 (Smart EPD, 2025)
EPA PCR Criteria	-	Updated PCR to address requirements of Basic PCR Criteria from US EPA Criteria for PCRs to Support the Label Program for Low Embodied Carbon Construction Materials. Office of Chemical Safety and Pollution Prevention. EPA-740-R-24-009. v.1, 2024.
Alignment with Part A	NSF does not have a Part A PCR for building and construction products	Methodological aspects such as Averaging rules, Impact assessment indicators and methods, assumptions around product and packaging disposal rates, waste regulations, handling of renewable electricity, foreground and background data requirements, and EPD Content reporting are specified in the Smart EPD Part A, which applies to all content in this Part B unless specified otherwise.
Data Requirements	Limited guidance beyond ISO 21930 on foreground and background data quality requirements and reporting	More stringent requirements for data specificity and reporting
Scenarios	Limited default scenarios for transport, installation, and disposal	More detailed and specific default scenarios for transport, installation, and disposal.

CONTENTS

Introduction 4
PCR Development History 5
1. Scope 9
1.1. Category Definition and Description 9
1.2. Geography 11
1.3. Applicable Products 12
1.4. Non-Applicable Products 12
2. Normative References 12
3. Terms and Definitions 14
4. Abbreviated terms 17
5. General aspects 19
5.1. Objectives 19
5.2. Life cycle stages, information modules, and module D 19
5.3. Average EPDs 20
5.4. Use of EPDs for Construction Products 22
5.5. Comparability 22
5.6. Documentation 22
6. PCR Development and Use 22
6.1. Core Structure 22
6.2. Relation Between Part A PCR and Part B PCRs 22
6.3. Development of Part B PCR 22
7. Rules for Life Cycle Assessment 23
7.1. LCA Methodological Framework 23
7.2. Inventory Analysis 34
7.3. Impact Assessment Indicators 36
8. Additional Environmental Information 36
8.1. General 36
8.2. Additional environmental information not included in the pre-set LCIA indicators 36
8.3. Additional environmental information not derived from or related to LCA 36
8.4. Mandatory Additional Environmental Information 39
9. EPD Content 40
9.1. Main Sections of an EPD 40
9.2. General Information 40
9.3. Methodological Framework 40
9.4. Technical Information and Scenarios 44
9.5. Environmental Information from LCA 46

9.6. Additional Environmental Information 47
9.7. Interpretation 47
9.8. References 47

INTRODUCTION

This document provides Product Category Rules (PCR) under Smart EPD, a type III environmental declaration program according to ISO 14025. The rules in this document serve as a subcategory PCR, known as a Part B PCR ("Part B"), to the Smart EPD Part A Product Category Rules for Building and Construction Products and Services, Standard 1000 ("Part A PCR")[1]. The intended application of this Part B is to give guidelines for the development of EPDs according to the product category scope defined in Section 1.1 and to further specify the underlying requirements of the supporting life cycle assessment (LCA). The sections in this document follow the structure of the Smart EPD Part A PCR and ISO 21930, providing clarification where needed and deferring to Part A and ISO 21930 where no changes are implemented.

When using this Part B, the most recent published version of the Smart EPD Part A PCR shall be used in conjunction with it. Smart EPD Part B PCR should be adapted if used by another EPD Program Operator that wishes to combine it with their own Part A PCR in accordance with ISO TS 14029:2022, 8.2 PCR harmonization and ISO 14027:2017, 6.4.3 Adaptation of existing PCR.

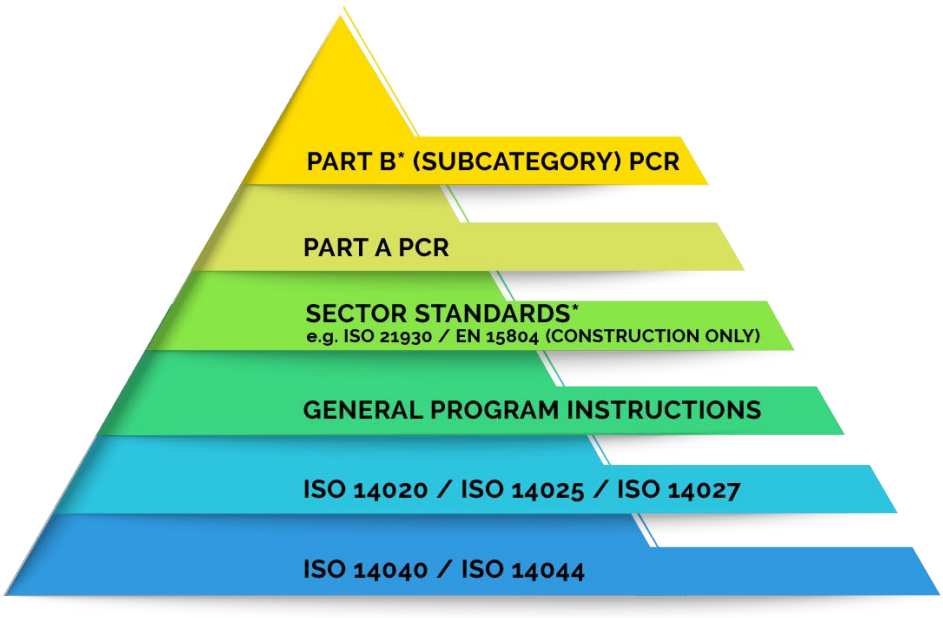
Environmental Product Declarations (EPDs), or Type III environmental declarations, are information disclosures about the environmental impacts associated with products, services, and systems from a life cycle perspective. The overall goal of an EPD is to communicate relevant, verified, and comparable information based on the science of life cycle assessment (LCA). These declarations are transparent information disclosures that facilitate informed decision-making and support comparisons among competing products, services, or systems that fulfil the same functions.

The Smart EPD program seeks to help organizations communicate the environmental performance of their products, services, and systems in a transparent and credible manner. EPDs derived from this program must be based on an LCA conducted in a manner consistent with ISO 14040, 14044, 14025, ISO 21930 or EN 15804 (if relevant), and the corresponding relevant Product Category Rules.

The governance document for the Smart EPD Program, also known as General Program Instructions (GPIs), forms the basis of the administration and operation of the program and covers PCR development.

[1] The most recent version of the Smart EPD Part A PCR may be found at www.smartepd.com/PCR-Library

Figure 1. PCR and normative standard hierarchy



References to this document shall be provided as follows:
Smart EPD (2025) Part B Product Category Rules for Gypsum Panels. Version 2.0. Standard 1000-004. Published February 24, 2025. www.smartepd.com.

All rights reserved. No part of this document may be reproduced in any form or by any means without the prior written permission of Smart EPD, except in the case of brief quotations included in critical reviews and certain other non-commercial uses permitted by copyright law.

PCR Development History

PCR Committee

This PCR has been prepared by a moderator from Smart EPD (Anna Lasso, anna.lasso@smartepd.com) with input from the following interested parties in Table 1, each of which has completed a conflict-of-interest form.

Table 1. PCR Committee Participants

Name	Organization	Email
Deborah Callaway	PABCO Gypsum	deborah.callaway@pabcogypsum.com
Beth Cassese	SCS Global Services	bcassese@scsglobalservices.com
Ray Dabria	American Gypsum Company LLC	ray.dabria@americangypsum.com
Mark Englert	USG Corporation	menglert@usg.com

Name	Organization	Email
Kyle Flondor	USG Corporation	kflondor@usg.com
Derik Harlow	USG Corporation	dharlow@usg.com
Susan Hines	Gypsum Association	shines@gypsum.org
William Le Roy (Bill)	US EPA	le-roy.william@epa.gov
Mundise Mortimer	National Gypsum Company	mmortimer@nationalgypsum.com
Sam Schneider	Saint-Gobain	samantha.schneider@saint-gobain.com
Nagapooja Seeba	Georgia-Pacific	nagapooja.seeba@gapac.com
Marybeth Shea	Independent Consultant	marybeth.shea@gmail.com
Stacy Smedley	Building Transparency	stacy.smedley@buildingtransparency.org
Tobi Tommasini	Georgia-Pacific	tobi.tommasini@gapac.com
Sam Turetsky	Georgia-Pacific Building Products	sam.turetsky@gapac.com

Rationale for PCR Development and Reference LCAs

This PCR was developed to facilitate the creation and publication of EPDs for Gypsum Panels. This PCR supports the comparison of EPDs created using this PCR by enabling consistency in reporting and methodology.

Per ISO 14027, Section 6.4.3, this PCR is an update to and adaptation of the NSF PCR for Gypsum Panel Products v1.1[2]. The Gypsum Association requested an update to the NSF PCR under the Smart EPD Program to include an optional cradle-to-grave scope expansion, revise scenario assumptions, and document the end-of-life fate of gypsum panels, including recycling and beneficial reuse. The update involved a thorough committee review of all PCR sections to determine further updates based on changes to industry norms and best available data.

Per ISO 14027 (Figure 2), ISO 14025 (Annex A), and the EPA PCR Criteria 2.2, details of the reference LCAs considered in the development of this PCR are presented below in Table 2.

[2] Available at: https://d2evkimvhatqav.cloudfront.net/documents/pcr_gypsum_panel_products_2019_1.1.pdf?v=1594929936 (Accessed September 9, 2024)

Table 2. Reference LCA Criteria for this PCR and EPA PCR Criteria 2.2

EPA PCR Criteria 2.2	Reference LCA Information
LCA Title, Link, and Publication	• An Industry Average Cradle-to-Gate Life Cycle Assessment of 1/2" Regular and 5/8" Type X Glass-mat Gypsum Board for the USA and Canadian Markets. Commissioner: Gypsum Association. Conducted by: Athena Sustainable Materials Institute. April 2021[3]. • An Industry Average Cradle-to-Gate Life Cycle Assessment of 1/2" Lightweight and 5/8" Type X Conventional Gypsum Board for the USA and Canadian Markets. Commissioner: Gypsum Association. Conducted by: Athena Sustainable Materials Institute. April 2020.[4]
Accessibility	https://gypsum.org/life-cycle-resources/
ISO conformance	ISO 14040, 14044, 14025, 21930
LCA scope alignment with this PCR	The scope of the Industry Average Reference LCAs for Glass-mat and conventional gypsum board considers a cradle-to-gate scope; however, this PCR supports EPDs that are cradle-to-grave in scope. The PCR Committee surveyed the following reference LCAs that serve as justification of a cradle-to-grave scope expansion for this PCR. • Life Cycle Assessment of Plasterboard, ERM on behalf of WRAP. • Life Cycle Assessment of Plasterboard Production: A UK Case Study, Sustainability 2024. 16(9), 3564; https://doi.org/10.3390/su16093564. • Comparative Life Cycle Assessment of gypsum plasterboard and a new kind of bio-based epoxy composite containing different natural fibers. Journal of Cleaner Production. V. 185, June 2018. https://doi.org/10.1016/j.jclepro.2018.03.042 These studies account for waste impacts from installation (A5) and do not include impacts for use modules (B1 – B7), which are assumed to be zero based on the collective knowledge of the PCR committee members. This is also corroborated in one study, which explicitly states "The material, once used in the construction, does not generate any impact to the environment, being the use phase the less relevant for the analysis of the impacts of building materials." These three studies also include impacts from demolition and waste treatment at end of life (C1 – C4).
Is Attributional	Yes
Conforms With ISO 21930 Allocation Rules	• Yes. Mass is used as the physical parameter for allocating flows between the products of interest and other co-products to calculate the input energy flows (electricity, natural gas, propane, etc.), shipping and packaging materials, lubricants, hydraulic fluid, greases, and oils, total water consumption, process emissions to air, water and land and waste flows • FGD gypsum is considered secondary material/recovered waste. • No burden is allocated to by-products such as off-spec gypsum boards, side rolls, downgraded rolls, or other rocks from gypsum ore extraction sites.

REVIEW HISTORY

An open public consultation was conducted during the PCR review process where interested parties were invited via email and other channels to submit comments to Smart EPD. The public consultation of the completed draft PCR included a minimum 30-calendar-day period from June 13 to July 15, 2024. After public comments were submitted, the PCR committee reviewed and developed responses for all comments. All comments from the review panel and public consultation were addressed and satisfactorily resolved by the PCR committee prior to the publication of this PCR. Interested parties who submitted comments include:

- Bill LeRoy, U.S. EPA
- Saint-Gobain North America
- Susan Hines, Gypsum Association
- Beth Cassese, SCS Global
- Tobi Tommasini, Georgia-Pacific

The independent panel review of this PCR included a review by the following individuals from October 23, 2024 to February 21, 2025:

Jack Geibig (Chair)	**Michael Gardner**	**Gaurav Das**
Ecoform	Independent Consultant	Independent Consultant
jgeibig@ecoform.com	michael@mgardnerservices.com	gd30gcc@gmail.com

This PCR was reviewed for and is in conformance with the following standards/guidelines:

- ISO 14025:2006
- ISO/TS 14027:2017
- ISO 21930:2017
- EN 15804:2012+A2:2019/AC:2021– optional conformance possible[5]
- ACLCA PCR Open Standard v1.0, 2022
- Smart EPD Part A, v1.01
- Smart EPD General Program Instructions, v1.0[6]

[3] Available at: https://gypsum.org/life-cycle-resources/ (Accessed September 9, 2024)

[4] Available at: https://gypsum.org/life-cycle-resources/ (Accessed September 9, 2024)

[5] There are various inconsistencies between ISO 21930 and EN 15804. This Part B follows ISO 21930 requirements; however, conformance to EN 15804 is possible and specific requirements to do so are indicated in Smart EPD Part A PCR for Building and Construction Products, Appendix.

[6] Available at: www.smartepd.com/resources (Accessed September 9, 2024)

1. SCOPE

Title:	**Part B Product Category Rules for Gypsum Panels, Smart EPD 1000-004**
Version Number:	2.0
Program Operator:	Smart EPD LLC, www.smartepd.com, info@smartepd.com
Publication date:	February 24, 2025
Validity period:	5 years
Specification code:	CSI: 092816, 092819, 092900, 061643
Standards conformance:	• Smart EPD® Part A Product Category Rules for Building and Construction Products • ISO 14025:2006 • ISO 21930:2017 with optional EN 15804+A2 conformance • ISO/TS 14027:2017 • ACLCA PCR Open Standard

1.1. CATEGORY DEFINITION AND DESCRIPTION

The scope of this PCR applies to the product group "gypsum panels" and includes interior and exterior gypsum panel products as defined by ASTM C11, *Standard Terminology Relating to Gypsum and Related Building Materials and Systems*.

Due to its inherent fire resistance, gypsum panels are the premier building material for wall, ceiling, and partition systems in residential, institutional, and commercial structures. Designed to provide a monolithic surface when joints and fastener heads are covered with a joint treatment system, gypsum panels also provide sound control, economy, versatility, quality, and convenience.

Gypsum is approximately 21 percent by weight chemically combined water, which greatly contributes to its effectiveness as a fire resistive barrier. When gypsum board or gypsum plaster is exposed to fire, the water is slowly released as steam, effectively retarding heat transmission and protecting wood or steel structural members.

Gypsum panels are defined in ASTM C11, *Standard Terminology Relating to Gypsum and Related Building Materials and Systems*. Refer to GA-235, *Gypsum Board Typical Mechanical and Physical Properties,* for more information on characteristics, properties, and performance.

Gypsum board is the technical product name used by manufacturers for a specific board with a gypsum core and a paper facing and may be further described as follows:

- **Regular Gypsum Board** – a gypsum board with naturally occurring fire resistance from the gypsum in the core.

- **Type X Gypsum Board** – a gypsum board with special core additives to increase the natural fire resistance of regular gypsum board as defined in GA-600 *Fire Resistance and Sound Control Design Manual*.

Glass Mat Gypsum Panel is the technical product name for a gypsum panel consisting of a noncombustible, moisture-resistant core with fiberglass facers on both the front and back surfaces and long edges. The applicable product manufacturing standard is ASTM C1177.

Coated glass mat water-resistant gypsum backing panels are designed primarily to be used as a base for the application of ceramic or plastic tile on walls or ceilings. The applicable product manufacturing standard is ASTM C1178.

Refer to GA-223-2017 *Gypsum Panel Products Types, Uses, Sizes, and Standards* for typical uses of, and applicable ASTM standards for each type of gypsum panel. Also included is the appropriate industry standard designation for the installation of each panel type, along with the sizes and thicknesses generally available.

This PCR covers all gypsum panels not identified as non-applicable products in Section 1.4 below. These include, but are not limited to, those products listed in Table 1.

Table 3. Gypsum panel classifications and sub-categories according to GA 223[7]

Standard	Class	Sub-categories
ASTM C1396	**Gypsum Board**	• Gypsum Wallboard • Gypsum Ceiling Board • Gypsum Sheathing • Exterior Gypsum Soffit Board • Water-Resistant Gypsum Backing Board • Gypsum Backing Board • Gypsum Lath • Gypsum Base for Veneer Plaster • Gypsum Shaftliner Board • Predecorated Gypsum Board • Gypsum Board for Manufactured Housing[8] • Abuse-Resistant Gypsum Panel[8] • Impact-Resistant Gypsum Panel[8]
ASTM C1658	**Glass Mat Gypsum Panels**	• Glass Mat Interior Gypsum Panel • Glass Mat Water-Resistant Gypsum Panel • Glass Mat Shaftliner Gypsum Panel • Glass Mat Abuse-Resistant Gypsum Panel • Glass Mat Impact-Resistant Gypsum Panel
ASTM C1278	**Fiber-Reinforced Gypsum Panels**	
ASTM C1177	**Glass Mat Gypsum Substrate for Use as Sheathing**	
ASTM C1178	**Coated Glass Mat Water-Resistant Gypsum Backing Panel**	
ASTM C1766	**Factory-Laminated Gypsum Panel Products**	

1.2. GEOGRAPHY

This PCR was developed with a focus on North America but may be applied to other global contexts.

[7] GA-223 may be downloaded at https://www.gypsumpublications.com/product/2218/gypsum-panel-products-types-uses-and-standards-pdf-download-ga-223-2021

[8] Manufactured housing board, abuse- and impact-resistant panels are not defined in C1396.

1.3. Applicable Products

Table 2 describes the product systems covered within the scope of this PCR, along with their relevant Construction Specification Institute (CSI) MasterFormat codes.

Table 4. Applicable Masterformat (CSI), UNCPC, and/or other Classifications

Classification scheme	Number(s)	Title
CSI	09 28 16	Glass-mat Faced Gypsum Backing Boards
	09 28 19	Fibered Gypsum Backing Boards
	09 29 00	Gypsum Board
	06 16 43	Gypsum Sheathing
UNCPC	314	Boards and Panels
UNSPSC	30161509	Gypsum Board

1.4. Non-Applicable Products

The following products, which may provide similar functions in a different application, are not within the scope of this PCR:

- Products without a gypsum core
- Products with a cementitious core
- Plaster
- Fire treated wood structural panels (covered by Product Category Rule (PCR) Guidance for Building-Related Products and Services Part B: Structural and Architectural Wood Product EPD Requirements. UL Environment. Standard 10010-9, Edition 1.1. October 2019.))
- Roof cover protection boards (covered by Product Category Rule (PCR) Guidance for Building-Related Products and Services Part B: Roof Cover Protection Board EPD Requirements. UL Environment. Standard 10010-36, Edition 1. November 2021.)
- Cladding (covered by Product Category Rule (PCR) for Preparing an Environmental Product Declaration (EPD) for Product Group Cladding Systems Products. UL Environment. Standard 10010-25, Edition 2. April 2021.)

2. Normative References

The following documents are referred to in the text. If the reference is undated, refer to the latest edition of the referenced document (including amendments).

ASTM C11 – 24 Standard Terminology Relating to Gypsum and Related Building Materials and Systems

ASTM C474-15(2020) Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction

ASTM C1177/C1177M-24 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C1178/C1178M-24 Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel

ASTM C1278/C1278M-24 Standard Specification for Fiber-Reinforced Gypsum Panel

ASTM C1396/C1396M-17 Standard Specification for Gypsum Board

ASTM C1658/C1658M-19e1 Standard Specification for Glass Mat Gypsum Panels

ASTM C1766-15(2019) Standard Specification for Factory-Laminated Gypsum Panel Products

ASTM E2921 – 16a, Standard practice for minimum criteria for comparing whole building life cycle assessments for use with building codes, standards, and rating systems

Bhat, C.G., Adhikari T, Mellentine J, Feraldi R, Lasso A, Swack T, Mukherjee A, Dylla H, Rangelov M. 2022 ACLCA PCR Guidance – Process and Methods Toolkit. Version May 2022. American Centre for Life Cycle Assessment

C1881-20 Standard Guide for Closed-Loop Recycling of Scrap Gypsum Panel Products
EN 15804+A2:2019/AC:2021 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

GA-214-2021 Recommended Levels of Board Finish

GA-223-2021 Gypsum Panel Products, Types, Uses, Sizes, and Standards

GA-235-2023-Gypsum Board Typical Mechanical and Physical Properties

GA-254-2017 Fire-Resistant Gypsum Sheathing

GA-600-2024 Fire Resistance and Sound Control Design Manual

ISO 14020:2022 Environmental statements and programmes for products — Principles and general requirements

ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – principles and procedures

ISO/TS 14027:2017 Environmental labels and declarations — Development of product category rules

ISO 14029:2022 Environmental statements and programmes for products — Mutual recognition of environmental product declarations (EPDs) and footprint communication programmes

ISO 14040:2006/Amd1:2020 Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006/Amd1L2017/Amd2:2020 Environmental management – Life cycle assessment – Requirements and guidelines

ISO 14046:2014 Environmental management – Water footprint – Principles, requirements and guidelines

ISO 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and guidelines for quantification

ISO 14071:2014 Environmental management – Life cycle assessment – Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006

ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

Smart EPD Part A Product Category Rules for Building and Construction Products and Services. Standard 1000.

Sustainable Mind Part B Product Category Rules for Joint Compound, v2. Part B#24-002.

US EPA Criteria for PCRs to Support the Label Program for Low Embodied Carbon Construction Materials. Office of Chemical Safety and Pollution Prevention. EPA-740-R-24-009. v.1, 2024.

3. TERMS AND DEFINITIONS

For the purposes of this document, the terms and definitions given in the following standards apply: ISO 14040:2006/Amd1:2020, ISO 14044:2006/Amd1:2017/Amd2:2020, ISO 14046:2014, 14025:2006, ISO 14027:2017, ISO 14029:2022, ISO 14067:2018, ISO 14071:2014, ISO 21930:2017.

In addition, the following definitions apply to this document:

Part A PCR/Core PCR

A core PCR, also referred to as Part A PCR, provides the foundational rules and requirements for conducting a Life Cycle Assessment (LCA) and developing Environmental Product Declarations (EPDs) across a broad category of products or services. It sets the overarching framework that applies to multiple product categories, ensuring consistency and standardization in the methodology used for LCA and EPA creation.

LCA Project Report
An LCA Project Report is a comprehensive document that details the methodology, data, and results of a Life Cycle Assessment (LCA) conducted for a product or service, particularly in the context of developing an Environmental Product Declaration (EPD) according to a Product Category Rule (PCR). An LCA Project Report is the supporting methodology report that conforms to ISO 14040, 14044, 14025, 21930 and the applicable PCR and provides the necessary documentation to verify the LCI, LCIA and additional environmental information reported in an EPD.

Part B PCR/Sub-category PCR
A Part B PCR is a product-specific document that complements the Core or Part A PCR. It provides detailed, category-specific rules and requirements for conducting Life Cycle Assessments (LCAs) and developing Environmental Product Declarations (EPDs) for a particular product or service category. While the Part A PCR establishes general guidelines applicable across various product categories, the Part B PCR tailors these guidelines to the unique characteristics of a specific product group.

Agitator
A device used to mix or stir materials, such as in the preparation of gypsum slurry.

Beneficiation
The process of improving the physical or chemical properties of raw gypsum material through various treatments.

Calcination
A thermal treatment process in which a carbonate material, such as limestone (calcium carbonate, $CaCO_3$), is heated to a high temperature in the absence of air or in a controlled atmosphere. This process causes the material to undergo a chemical transformation. In the context of industrial processes, calcination is specifically associated with the decomposition of calcium carbonate into calcium oxide (CaO, or quicklime) and carbon dioxide (CO_2) gas.

Calcination (gypsum)
The process of heating gypsum to remove water, converting it into a usable form of plaster (ASTM C22 – C22M).

Carbonization
Carbon dioxide reaction with cementitious products to form calcium carbonate (ISO 21930:2017, Section 3.8.1).

Dextrose
A simple sugar, often used as an additive in gypsum board production for various properties.

Fiberglass facers
A type of facing material made of fiberglass used on gypsum panels to enhance strength, moisture resistance, and fire resistance (ASTM C1658 – C1658M).

Fiberglass reinforced gypsum panels
Gypsum panels reinforced with fibers (e.g. glass fibers) to improve their structural strength and impact resistance (ASTM C1278 – C1278M).

Flue gas desulfurization
A process to remove sulfur dioxide from exhaust flue gases, commonly used in power plants; produces synthetic gypsum as a byproduct.

Foil backing
A layer of foil applied to the back of gypsum panels to provide a vapor barrier or reflective insulation (ASTM C1396 – C1396M).

Glass mat
A woven or nonwoven fabric of glass fibers with or without a binder (ASTM C11 – 24).

Glass-mat gypsum panel
A gypsum panel product with glass mat facers (ASTM C11 – 24).

Gypsum board
A type of gypsum panel product consisting of a noncombustible core primarily of gypsum with paper surfacing (ASTM C11 – 24).

Gypsum panels
The general name for a family of sheet products consisting essentially of gypsum (ASTM C11 – 24).

Joint compound
A plaster-like material used to fill and smooth joints between gypsum boards (ASTM C475 – C475M).

Joint tape
A tape used in conjunction with joint compound to cover seams between gypsum boards (ASTM C475 – C475M).

Joint treatment system
A system involving the application of joint tape and joint compound to cover the joints between gypsum board panels, creating a smooth surface for finishing (ASTM C475 – C475M).

Laminated gypsum panels
Gypsum panels that are laminated with additional materials, such as insulation or decorative finishes, for enhanced performance (ASTM C1396 – C1396M).

Monolithic surface
A surface that appears seamless.

Paper-faced gypsum board
Gypsum board with paper facing on both sides, commonly used for walls and ceilings (ASTM C1396 – C1396M).

Primary coarse screening
The initial screening process used to remove large impurities from gypsum material during processing.

Pulper
A machine or device used to disaggregate and break down recycled gypsum board into a slurry or pulp form for reuse.

Steel slag
A byproduct from the steelmaking process, used in various application including construction materials.

4. ABBREVIATED TERMS

ACLCA	American Centre for Life Cycle Assessment
ASTM	ASTM International
ANSI	American National Standards Institute
CSC	Constructions Specifications Canadian
CSI	Construction Specifications Institute
EN	European Norm
EPD	Environmental Product Declaration
FGD	Flue Gas Desulfurization
GPI	General Program Instructions
GWP	Global Warming Potential
ISO	International Organization for Standardization
kW	Kilowatt
kWh	Kilowatt Hour
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
MJ	Megajoule
MW	Megawatt
PCR	Product Category Rule
RSL	Reference Service Life

UNCPC	United Nations Central Product Classification
UNSPSC	United Nations Standard Products and Services Code

5. GENERAL ASPECTS

5.1. OBJECTIVES

Per Part A, Section 5.1, with additional clarification:

The objective of these Product Category Rules (PCR) is to provide specific rules for the assessment and reporting of the environmental performance of gypsum panels as per ISO 21930:2017 for use in building and civil engineering works. This product category is defined as per the most recent version of ASTM C11*Terminology* family of sheet products consisting essentially of gypsum, including but not limited to: paper-faced gypsum board, glass-mat gypsum panels, fiber reinforced gypsum panels, and laminated gypsum panels.

This PCR serves as a sub-category PCR, or Part B PCR, to the Smart EPD Part A PCR for Building and Construction Materials.

The US EPA PCR Criteria (2024)[9] and the American Center for Life Cycle Assessment (ACLCA) PCR Guidance version 1.0 (2022) – Process and Methods Toolkit Checklist was used to guide the creation of this PCR. EPDs created using this PCR Part B shall conform with the "Procurement" use case as defined by the ACLCA PCR Guidance.[10]

5.2. LIFE CYCLE STAGES, INFORMATION MODULES, AND MODULE D

Per Part A, Section 5.2 (ISO 21930, Section 5.2), with the following clarification:

The scope EPDs published using this PCR Part B is presented in Table 3.

Table 5. EPD Scopes, Life Cycle Modules, Declared/Functional Unit, and RSL

Scope of EPD	Included Life Cycle Modules	Declared or Functional Unit	Reference Service Life
Cradle to gate	A1 – A3	Declared Unit	Not specified
Cradle to gate with installation	A1 – A3, A4, A5	Declared Unit	75 years
Cradle to gate with end of life	A1 – A3, C1 – C4	Declared Unit	75 years
Cradle to grave	A1 – A3, A4, A5, B1 – B7, C1 – C4	Functional Unit	75 years

[9] https://www.epa.gov/system/files/documents/2024-10/final-pcr-criteria_8-7-24_5081_0.pdf [Accessed January 9, 2025]

[10] Accessible at https://aclca.org/pcr/

The system boundary for gypsum panels is presented in Figure 2.

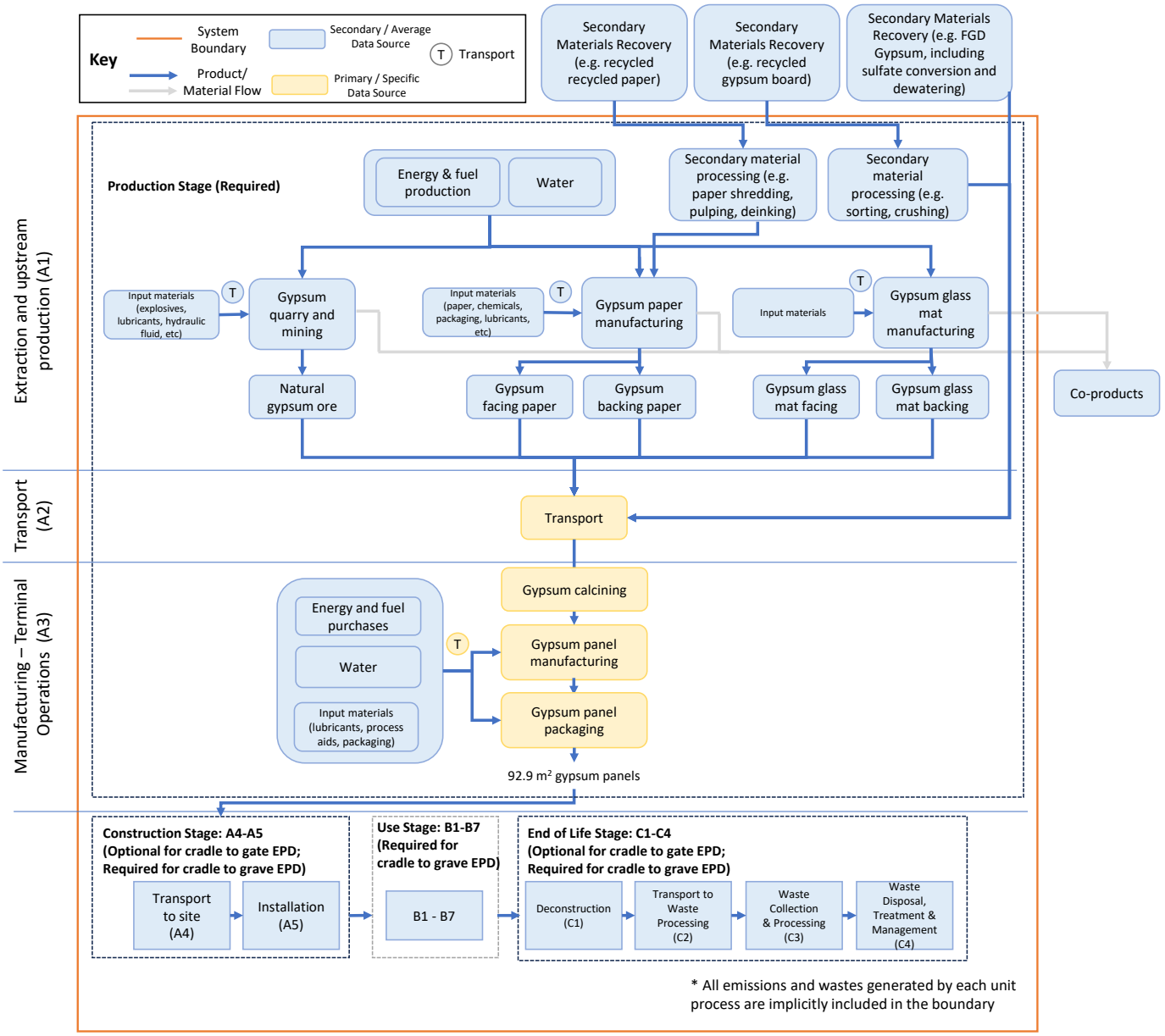


Figure 2. System boundary for gypsum panels

5.3. AVERAGE EPDS

Per Part A, Section 5.3 (ISO 21930, Section 5.3) with the additional clarifications noted in the subsections below.

5.3.1. Product Specificity

Per Part A, Section 5.3.1.

5.3.2. Manufacturing Specificity

Per Part A, Section 5.3.2.

5.3.2.1. Manufacturer-Average and Facility-Specific EPDs

Per Part A, Section 5.3.2.1, with the following clarification:

When preparing an average EPD for an identical product (gypsum panel) manufactured at multiple facilities, a mass-weighted average based on total annual production of each facility shall be used as the basis for calculating the average. Data reported in the declarations shall be as production mass-weighted averages of multiple facilities.

5.3.2.2. Industry Average EPDs

Per Part A, Section 5.3.2.2, with the following clarification:

A call for involvement of interested parties in the creation of an industry-average EPD shall be published in at least one industry trade publication. At a minimum, at least one manufacturing location from each participating company should be involved and represented in an industry-average EPD.

An industry organization shall inform all eligible industry participants of the industry-average EPD process. Confidential business information shall be collected by a third party and be aggregated with no trace to the original source of the data. The development or update of an industry-average EPD should involve a series of meetings or exchanges to allow all participants the ability to contribute to the development.

An update to an industry-average EPD, or new EPD, may need to be developed at the discretion of the EPD owner prior to the typical 5-year period due to the following:

- significant changes to the manufacturing process;
- significant changes to the raw material inputs;
- major regulatory changes that affect operational procedures.

Additional companies wishing to participate in an industry-average EPD may be added to the industry-average at any time the industry-average EPD is updated or a new industry-average EPD is developed.

5.3.2.2.1. Industry-Average EPD Participation

Per Part A Section 5.3.2.2.1, with the following revision:
In order to participate in an industry-average EPD, a

manufacturer shall provide primary manufacturing data for the calculation of the initial EPD average.

5.3.2.2.2. Industry-Average EPD Retroactive Participation

Per Part A Section 5.3.2.2.2, with the following revision:

This PCR does not support the retroactive participation of companies in an industry-average EPD. Any company that did not participate in the initial industry-average EPD that wants to participate must wait for the next update of the industry-average EPD.

Manufacturers that wish to publicly benchmark a product specific EPD against the industry-average EPD shall have participated in the industry-average EPD process.

5.3.3. Multiple Sets of EPD Results and Scaling Factors

Per Part A, Section 5.3.3.

5.4. Use of EPDs for Construction Products

Per Part A, Section 5.4 (ISO 21930, Section 5.4).

5.5. Comparability

Per Part A, Section 5.5 (ISO 21930, Section 5.5).

5.6. Documentation

Per Part A, Section 5.6 (ISO 21930, Section 5.6), with additional, specific content for EPDs published using this Part B PCR in Section 9.

6. PCR Development and Use

6.1. Core Structure

Per Part A, Section 6.1 (ISO 21930, Section 6.1).

6.2. Relation Between Part A PCR and Part B PCRs

Per Part A, Section 6.2 (ISO 21930, Section 6.2).

6.3. Development of Part B PCR

Per Part A, Section 6.3 (ISO 21930, Section 6.3). See Section 1 for additional context.

7. RULES FOR LIFE CYCLE ASSESSMENT

7.1. LCA METHODOLOGICAL FRAMEWORK

7.1.1. LCA MODELLING AND CALCULATION

Per Part A, 7.1.1 (ISO 21930:2017, Section 7.1.1).

7.1.2. FUNCTIONAL UNIT

Per Part A, Section 7.1.2 (ISO 21930:2017, Section 7.1.2), with the following clarification:

The functional unit for gypsum panels is 92.9 m^2 (1000 ft^2) of installed product with an RSL of 75 years. In the North American market, gypsum panels are typically specified and sold on an area basis.

The functional unit shall be reported in Section 9.3.1.

This PCR applies to a wide variety of gypsum panel product types, offered in a variety of thicknesses, facing materials, and other additives to achieve desired performance outcomes that may impact results. Since this PCR uses an area-based functional unit, declarations for the thickness and mass shall be indicated as set out in Section 9.3.1, Table 9.

7.1.3. DECLARED UNIT

For EPDs not covering the complete life cycle, a declared unit may be defined. For this PCR, declared units may only be defined for cradle to gate, cradle to construction site, cradle-to-installation, or cradle to gate with end-of-life EPDs. EPDs that include the use stage cannot use a declared unit. EPDs that use a declared unit cannot be used as a basis for comparison. Note that a declared unit shall be applied if the precise function of the product is not stated or not known.

The declared unit for gypsum panel products is 92.9 m^2 (1000 ft^2). Mass and thickness of the gypsum panel product must also be reported with the declared or functional unit as per Table 6.

The declared unit shall be reported in Section 9.3.1.

7.1.4. REFERENCE SERVICE LIFE

Per Part A, Section 7.1.4 (ISO 21930:2017 Section 7.1.4), with the following clarification:

For EPDs reporting a functional unit and/or considering use phase impacts in B1-B5, this PCR assumes an RSL of 75 years, which is consistent with industry standards and experts in the field. The PCR also assumes a building estimated service life (ESL) of 75 years, which is consistent with the 75-year building service life identified in ASTM E2921

(2022, Section 6.1.1) and ASHRAE 189.1 (2020, Section 9.5.1.2).

For further discussion, see Part A Section 7.1.4 and ISO 21930:2017 Annex A.

7.1.5. System Boundary with Nature

Per Part A Section 7.1.5 (ISO 21930:2017 Section 7.1.5).

7.1.6. System Boundary with Product Systems

Per Part A Section 7.1.6 (ISO 21930:2017 Section 7.1.6), with additional clarification.

The system boundary for NA gypsum panels does not include the production of electricity from the coal-fired power plants that produce the Flue Gas Desulfurization gypsum. For more discussion, refer to Section 7.2.6 *Allocation Across System Boundary*.

Capital goods and infrastructure have been excluded per ISO 21930. Future PCR updates may consider capital goods and infrastructure when lifetimes or standardized methods of computing lifetimes for the industry become available, as well as consensus-based depreciation methods to allocate the burden of capital goods over their service period.

The system boundary for gypsum panels is presented in Section 5.2, Figure 2.

7.1.7. Information for Scenarios

7.1.7.1. General

Per Part A Section 7.1.7.1 (ISO 21930:2017, Section 7.1.7.1).

7.1.7.2. A1 to A3, Production Stage

Per Part A Section 7.1.7.2 (ISO 21930:2017 Section 7.1.7.2), with the following clarification:

7.1.7.2.1. General

Per Part A, Section 7.1.7.2.1 (ISO 21930, Section 7.1.7.2.1).

7.1.7.2.2. A1, Extraction and Upstream Production

Per Part A Section 7.1.7.2.2 (ISO 21930:2017 Section 7.1.7.2.2). The information module “extraction and upstream production” covers raw material extraction and processing as well as processing of secondary material input (e.g. recycling processes, including sorting, handling, transportation, and reprocessing).

The A1 information module includes the upstream production of all raw materials used in the gypsum panel, including the facers and backing materials (paper or glass mat) and the raw

materials used in the formulation of the panel (i.e., starch, boric acid, etc.). The upstream manufacturing of lubricants and other process aids used in the panel manufacturing are *not* included in this module. The following additional requirements apply:

- All listed processes shall include the input energy and fuel supply and the transport of input materials up to the mine / manufacturing gate.
- Gypsum quarry and mining processes shall include: drilling, blasting, excavating, pit loading, primary crushing, screening, conveying, truck hauling, water spraying, beneficiation operations, surface milling, road grading, stock piling, scaling, drilling / installing roof bolts to stabilize the roofing system, and the solid and liquid waste generated (transport & processing)
- Gypsum paper manufacturing shall include the following materials / processes: input materials (e.g., mixed waste papers, chemicals, packaging, lubricants, etc.), pulper, agitator, cleaning, high density cleaning, primary coarse screening, secondary screening, thickening, digester, storage tank, refining, blending, paper machining, drying, pressing, rewinding, cutting, wrapping, shipping, overhead operations of the manufacturing facility, internal transport of material and products, solid and liquid generated waste out-bound transport, including packaging waster, and wastewater treatment and out-bound transport
- Gypsum glass mat manufacturing processes shall include the following materials / processes: stacking, finishing, and bundling, overhead operations of manufacturing site, fabric filters, drum, dry, and cartridge filters, vents, precipitators, water sprinklers, wastewater treatment and out-bound transport (if applicable)
- Note: “Glass fibre” datasets alone are not a sufficient proxy for glass mat manufacturing. Additional processing and raw materials shall be added to accurately represent glass mat production.

7.1.7.2.3. A2, TRANSPORT TO FACTORY

Per Part A Section 7.1.7.2.3 (ISO 21930:2017, Section 7.1.7.2.3), with additional clarification:

The A2 information module includes average or specific transport of raw materials (including recycled materials), upstream products, and fuels from the extraction site or source to the manufacturing site / processing plant; this includes the transport from their source to the plant of any recovered materials, which are to be recycled and used in the panel manufacturing process. Transport shall include empty backhauls and interim transportation to distribution centers or terminals based on primary data.

In absence of primary data for raw material transport, the default of 500 miles (800 km) shall be used for the raw material transport to the manufacturing site (assumed to include interim transportation) and 300 miles (482 km) empty backhaul.

7.1.7.2.4. A3, MANUFACTURING

Per Part A Section 7.1.7.2.4 (ISO 21930:2017, Section 7.1.7.2.4), with additional clarification:

The manufacturing information module includes the following:

- Generation of electricity, steam, heat, and fuels from primary energy resources used in Gypsum Panel manufacturing, including their extraction, refining and transport[11].
- Consumptive water use for processing water (refer to ISO 21930:2017 Section 7.2.13) (e.g. dust mitigation, carbon treatment).
- Upstream impact of lubricants and other ancillary materials.
- Processing of raw materials.
- Emissions from the combustion of secondary fuels and waste used in the manufacturing process
- Primary packaging (e.g. end tape, including extraction, manufacturing, and transport).
- Waste management from manufacturing packaging and manufacturing wastage including transport up to the recycler/disposal with an empty backhaul.

[11] See Section 7.2.3 for a discussion of allocation of these inputs.

- On-site storage.
- A3 shall include an assumption of 5% material loss unless product specific data are available and transparently reported in the project LCA report.
- Any flows leaving the product system used for agricultural purposes shall be considered wastes and not co-products.

7.1.7.2.5. Input of Secondary Materials or Recovered Energy

Per Part A Section 7.1.7.2.5 (ISO 21930:2017, Section 7.1.7.2.5), with additional clarification:

The electricity utility performs all production processes associated with gypsum panel-grade Flue Gas Desulfurization (FGD) gypsum feedstock intended for manufacture under the provisions of ASTM Standard C1396. FGD gypsum is used without an upstream burden, including all treatments necessary to make it usable as a product input such as sulfate conversion and dewatering. For more discussion on FGD gypsum, refer to Section 7.2.6 *Allocation Across System Boundary*.

Recycled paper and recycled gypsum core may be used as inputs in module A1 and/or module A3. These materials shall be treated as secondary materials per ISO 21930. Section 7.1.7.2.5 but additional processing needed to convert the recovered, secondary materials into a usable flow, e.g. paper shredding, pulping, deinking, bleaching, papermaking, shall be accounted for in the gypsum panel system boundary in the information module in which the secondary material is used.

7.1.7.2.6. Co-Products Leaving the System

Per Part A Section 7.1.7.2.6 (ISO 21930:2017), Section 7.1.7.2.6, with additional clarification: there are no co-products associated with this stage. All materials leaving module A3 are considered waste.

7.1.7.2.7. Output of Waste

Per Part A Section 7.1.7.2.7 (ISO 21930:2017, Section 7.1.7.2.7).

7.1.7.2.8. End-of-Life Scenarios for Packaging

Per Part A Section 7.1.7.2.8 (ISO 21930:2017, Section 7.1.7.2.8).

7.1.7.3. A4 TO A5, CONSTRUCTION STAGE

Per Part A Section 7.1.7.3 (ISO 21930:2017 Section 7.1.7.3).

Additional clarification, boundaries with the technosphere, and/or with nature are noted below.

7.1.7.3.1. A4, TRANSPORTATION TO THE CONSTRUCTION SITE

This module shall include both transport from the factory gate to the central warehouse or intermediate distribution site (if relevant), as well as transport to the construction site. The distance to the construction site may be estimated based on weighted average distance to the market of the product. When specific primary data is not available, the following scenario shall be used:

- Distribution of gypsum panel product from the manufacturing gate to the distribution center gate is assumed as 448 km (280 miles) by commercial tractor-trailer truck and 208 km (130 miles) by rail (if applicable)
- Final transport from the distribution gate to the construction site is assumed as 40 km (25 miles) by a single unit truck with an empty backhaul.

Any exceptions to this scenario shall be justified in the LCA report and noted in the EPD.

7.1.7.3.2. A5, INSTALLATION

The default on-site installation waste scenario for all gypsum panel products shall be 10% on a surface area basis of product. Any exceptions shall be justified in the project LCA report and noted in the EPD.

For gypsum panel products, the ancillary materials required for installation shall include fasteners, joint tape, and joint compound. The amount of joint compound used during installation shall adhere to the PCR for joint compound[12], which specifies an installation scenario defined by a GA-214 Level 4 finish with the quality adjusted for the measured shrinkage (testing per ASTM C474) for a service life of 75 years.

[12] Sustainable Minds Part B for Joint Compound v2, available at https://www.sustainableminds.com/files/transparency/pgds/Part_B_Product_Group_Definition_Joint_Compound_v2_2024.pdf

The values in Table 5 account for a 1:1 ratio of conventional weight to lightweight joint compound, 1,250 screws, and 370 feet of joint tape. If available, specific, primary inventory data for joint compound should be used instead of the default values in Table 6.

Table 6. Ancillary Materials for Gypsum Panel Installation

Ancillary Material Name	Mass per FU (kg/92.9m^2)	Volume per FU (L/92.9m^2)
Lightweight Ready Mixed	27.4	23.6
Conventional Ready Mixed	41.2	25.1
Screws (1,250 per FU)	2.70	n/a
Joint tape (370 feet per FU)	0.90	n/a

Any packaging waste should be declared in this module, including mass, type, and biogenic carbon content of packaging if relevant. For joint compound waste, a 2:1 ratio of plastic pails to cartons shall be assumed, with 4.5-gallon pails and 3.5-gal cartons.

For the North American context, the default assumption is all gypsum panel installation waste is disposed of in an appropriate construction and demolition landfill, in line with current practices in the majority of North America. If primary data are available that support an alternative scenario, e.g. recycling or reuse, this may be used instead of the default assumption when justified in the project LCA report and noted in the EPD.

7.1.7.4. B1 TO B7, USE STAGE

Per Part A Section 7.1.7.4 (ISO 21930:2017 Section 7.1.7.4).

Impacts from gypsum panels during the use phase module B1may be reported as zero (“0”).

Gypsum panels are assumed to require no maintenance, repair, replacement or refurbishment during phases B2-B5 and may be reported as zero (“0”).

Additionally, for B6 and B7, gypsum panels are assumed to have no operational energy or water use (respectively) during the use phase of the product and may be reported as zero (“0”).

7.1.7.5. C1 TO C4, END OF LIFE STAGE

Per Part A Section 7.1.7.5 (ISO 21930:2017 Section 7.1.7.5), with the following clarification:

Primary data shall be used, if known and available, for end of life scenarios (e.g. Product take-back programs, recycling, etc.). When end of life data are unknown, this PCR supports the generic scenario for the North American context that all gypsum panels shall be disposed in an appropriate construction and demolition landfill, in line with normal North American gypsum product industry practices. In the absence of primary data, the following assumptions shall be made in the LCA and EPD and reported in Section 9.4.2 of the EPD.

- Impacts from C1 (deconstruction / demolition) shall be assumed as zero ("0") based on manual labor using hand tools.
  - *Deconstruction* describes the process used when installed gypsum panels are slated for recycling and / or beneficial reuse[13]. Using manual tools, panels are carefully separated from framing members to maintain panel integrity and avoid dissolution. Deconstruction to remove valuable materials can take place prior to demolition.
  - *Demolition* describes the process of razing a structure to the ground, and is not compatible with recovery or beneficial reuse of gypsum panels. While demolition is possible with hand tools, even residential structures often rely on heavy equipment for demolition.

- C2 (end-of-life transportation) shall include the transport of gypsum panel waste from the building to the landfill site per the assumptions in Table 5.

Table 7. Module C2 Transportation Assumptions[14]

Transport mode	Mass percent	Distance (km)
Truck (capacity utilization = 0.75, empty backhaul)	74.6%	44
Rail	25.4%	469

[13] One beneficial reuse of gypsum products concerns agricultural application as a soil amendment.

[14] Values taken from Table 2-5 of EPA "Life Cycle Inventories of End-of-Life Pathways of Construction and Demolition Materials" EPA 600/R-21/162, July 2021.

- C3 (waste processing) shall assume that no gypsum panel waste goes to a waste processing facility prior to disposal in the landfill; impacts shall be assumed as zero ("0"). For more discussion around waste processing at end of life, refer to Annex: End of Life Considerations.
- C4 (waste disposal) shall assume that the gypsum panel is disposed of in an appropriate landfill[15]. For more discussion around waste disposal at end of life, refer to Annex: End of Life Considerations.

Any scenario not following the above assumptions for end-of-life of gypsum panel products must be documented and justified.

7.1.7.6. Module D

Module D is excluded from the scope of this Part B PCR.

For discussion around recycling and beneficial reuse of gypsum panels, refer to Annex: End of Life Considerations.

7.1.8. Cut-off Rules

The requirements for the exclusion of inputs and outputs (cut-off rules) shall follow the guidance in Part A Section 7.1.8 (ISO 21930 Section 7.1.8). The procedure used shall be documented in Section 9.3.6.

7.1.9. Data Sources and Data Quality

Per Part A Section 7.1.9 (ISO 21930:2017 Section 7.1.9).

Foreground System and Data Collection

Per Part A, Section 7.9.1, "Foreground System and Data Collection," with additional clarification:

The foreground data flows of importance for gypsum panels include emissions from energy sources. The specific, primary data requirements for energy sources and other flows are detailed in Table 8. All foreground system data and calculation methodologies shall be documented in the LCA project report, including detailed product manufacturing data and the approaches used to calculate production-weighted averages. This includes methods of allocating transport distances by mode when sourcing material from multiple suppliers.

[15] Here, "appropriate landfill" may be an inert landfill unit process for the gypsum core and a "paper to landfill" unit process for paper. If a paper landfill process is unavailable, a municipal solid waste (MSW) landfill unit process may be chosen.

Table 8. Foreground data requirements

Foreground Data Flows	Data Requirement
Thermal energy quantity by source type	Primary data shall be used for unit processes in module A3.
Electricity quantities	Primary data shall be used in module A3.
Raw material quantities	Primary data shall be used in module A3.
Waste quantities	Primary data shall be used in module A3.
Inbound transport distances (A2)	Primary data should be use in module A2. If primary data are unavailable: 500 miles (800 km) shall be used for the raw material transport to the manufacturing site (assumed to include interim transportation) and 300 miles (482 km) empty backhaul.
Outbound transport distances from A3	Primary data should be used, if available, in module A3. In the absence of primary data, defaults of 44 km shall be used for non-hazardous waste. Wastes shall be assumed to be transported by truck. Transport shall include empty backhauls (bulk carriers that return empty).

Background System

Per Part A, Section 7.9.1, "Background System," with the following clarification:

As a rule, data specific to the product system shall be used, if available, for processes in the background system, e.g. gypsum paper manufacturing, gypsum glass mat manufacturing, and/or gypsum quarrying/mining.

If specific data are unavailable, a homogenous market with average or generic, secondary data may be assumed to appropriately represent the respective process.

Examples of these processes include electricity and fuel production, extraction and/or production of raw materials (e.g. gypsum ore), and manufacturing of upstream products where specific data are unavailable (e.g. glass mat).

The following background data sources shall be disclosed in EPD Content, Section 9.3.6.2:

- Electricity mixes (consumptive)
- Fuel sources
- Transportation mode (e.g. rail and truck)

- Raw material extraction/production
  - Gypsum ore
- Upstream product production
  - Glass mat
  - Gypsum paper

If specific data are used for any of these flows instead of average, generic data, they shall be identified as "specific data" in EPD Content, Section 9.3.6.2.

7.1.9.1. LCI Databases

Per Part A Section 7.1.9.1 (ISO 21930 Section 7.1.9.1).

7.1.9.2. Electricity grom the Grid

Per Part A Section 7.1.9.2 (ISO 21930 Section 7.1.9.2).

7.1.9.3. On-Site and Off-Site Renewable Electricity

Per Part A Section 7.1.9.3 (ISO 21930 Section 7.1.9.3), with the following clarification:

This Part B shall follow the most recent version of the ACLCA Guidance for Quantifying Renewable Electricity Instruments in Environmental Product Declarations (EPDs).

7.1.9.4. CO_2 Offsets

Per Part A Section 7.1.9.4 (ISO 21930 Section 7.1.9.4).

7.1.9.5. Waste Classification by Region

Per Part A Section 7.1.9.5 (ISO 21930 Section 7.1.9.5).

7.1.9.6. Incineration Energy

Per Part A Section 7.1.9.6 (ISO 21930 Section 7.1.9.6).

7.1.9.7. Mass Balance / Chain of Custody

Per Part A Section 7.1.9.7.

7.1.10. Units

Per Part A Section 7.1.10 (ISO 21930 Section 7.1.10). The preferred power and energy units are as follows:

- kWh or MJ for electric energy
- kW or MW for power.

7.2. Inventory Analysis

7.2.1. Data Collection

Data collection shall follow Part A, Section 7.2.1 (ISO 21930:2017, 7.2.1, which references ISO 14044:2006, 4.3.2).

The unit processes specified in Section 7.1.7 under the operational control of the EPD owner shall be collected from primary sources. If primary data are unavailable that are specific to the investigated product scope and supply chain, generic data may be used only when justified.

7.2.2. Calculation Procedures

Per Part A Section 7.2.2 (ISO 21930:2017 Section 7.2.2).

7.2.3. Allocation

Per the stepwise allocation method in Part A Section 7.2.3, 7.2.4, 7.2.5, and 7.2.6 (detailed in ISO 21930, Section 7.2.4, 7.2.5, and 7.2.6), with the following clarification:

Allocation methods used in key processes where an allocation issue is expected to arise shall be identified.

As shown in the reference industry average LCA studies in Table 2, the dominant contributors (>70%) to gypsum panel GWP emissions are electricity and natural gas used in both the calcining and drying operations. As such, electricity, fuels, and water inputs are to be allocated coming into module A3 on a mass basis such that the total plant utility usage (e.g., kwh/year, m3/year) is divided by the total production mass for all products then multiplied by the basis mass of the product of interest.

Allocation shall be based on the mass of gypsum panel products produced. Allocation related to transport shall be based on the mass of the transported product.

7.2.4. Principles for Allocation

Per Part A Section 7.2.4 (ISO 21930:2017 Section 7.2.4).

7.2.5. Co-Product Allocation

Per Part A Section 7.2.5 (ISO 21930:2017 Section 7.2.5), with the following clarification:

Per Part B Section 7.1.7.2.6, there are no co-products associated with module A3; all materials leaving module A3 are considered waste.

7.2.6. Allocation Across System Boundary

Per Part A Section 7.2.6 (ISO 21930:2017 Section 7.2.6), with further guidance as follows:

Flue Gas Desulfurization (FGD) gypsum is produced during the coal-fired power generation process and is used as an input in the manufacture of some NA gypsum panels. FGD gypsum is regarded as a waste material of the coal-fired power generation process, and thus is seen as a secondary material input for NA gypsum panels. The system boundary for NA gypsum panel products therefore does not include the production of electricity from the coal-fired power plants that produce the FGD gypsum; FGD gypsum is considered to be a burden-free input into the NA gypsum panel manufacturing process. The treatments required to make FGD gypsum into a usable product input to gypsum panel manufacturing are not included within the gypsum panel product system boundary. See Section 7.1.7.2.5 for more discussion.

7.2.7. Biogenic Carbon (if applicable)

Biogenic carbon uptake and emissions shall be calculated per Part A Section 7.2.7 (ISO 21930:2017, Section 7.2.7). and reported for each declared impact module in Section 9.5.2.3 of EPD Content.

For the production of gypsum panel products, recycled raw materials used to produce paper are counted as biogenic carbon inputs in addition to virgin paper, starch, and dextrose.

Biogenic carbon flows shall be characterized and reported in the LCA and EPD as follows:

- Entering the system boundary with -1 kg CO2e/kg CO2 biogenic carbon in module A1
- Exiting the system boundary as +1 kg CO2e/kg CO2 biogenic carbon in the following modules:
    - Module A3 (potential losses during manufacturing)
    - Module A5 (installation waste), and
- Exiting the system boundary as +1 kg CO2e/kg CO2 biogenic carbon in module C4.

7.2.8. Carbonation and Calcination (if Applicable)

Carbonation uptake and calcination emissions are not applicable to the scope of this PCR. While Figure 2 refers to a “Gypsum calcining” process in module A3, this is an industry term used to describe converting calcium sulphate dihydrate to calcium sulphate hemihydrate and is not associated with traditional calcination emissions.

7.2.9. Delayed Emissions

Per Part A Section 7.2.9 (ISO 21930:2017, Section 7.2.9), with additional clarification:

According to ISO 21930:2017, Section 7.2.9, there is no consensus on how to address delayed emissions in the calculation of GWP. “If a manufacturer wishes to declare quantitative or qualitative information on delayed emissions within the EPD, the information shall be reported under “Additional environmental information not derived

from LCA" (see ISO 21930, Section 9.6) and the underlying methodology shall be referenced." More detailed guidance and requirements may be provided here.

7.2.10. Resource Use Indicators

Per Part A Section 7.2.10, ISO 21930:2017, Section 7.2.10, ISO 21930, Section 7.2.13 and reported in Section 9.5.2.1 of EPD Content.

7.2.11. GHG Emissions from Land-Use Change (if Applicable)

Per Part A Section 7.2.11 (ISO 21930, Section 7.2.11) and reported in Section 9.5.2.3 of EPD Content.

7.2.12. Additional indicators describing Emissions and Removals of Carbon

Per Part A Section 7.2.12 (ISO 21930, Section 7.2.12) and reported in Section 9.5.2.3 of EPD Content.

7.2.13. Freshwater Inventory Indicator

Per Part A Section 7.2.13 (ISO 21930, Section 7.2.13) and reported in Section 9.5.2.1 of EPD Content.

7.2.14. Waste Categories and Output Flow Indicators

Waste and outputs flows shall be calculated and reported per Part A, Section 7.2.14 (ISO 21930, Section 7.2.14) reported in Section 9.5.2.2 of EPD Content.

7.3. Impact Assessment Indicators

Per Part A, Section 7.3 (ISO 21930, Section 7.3).

All environmental impacts are to be declared in the life cycle stage in which they occur.

8. Additional Environmental Information

8.1. General

Per Part A, Section 8.1 (ISO 21930:2017, Section 8.1).

8.2. Additional environmental information not included in the pre-set LCIA indicators

Per Part A, Section 8.2 (ISO 21930:2017, Section 8.2).

8.3. Additional environmental information not derived from or related to LCA

Per Part A, Section 8.3 (ISO 21930:2017, Section 8.3), with the following additions:

8.3.1. Hydrogen Sulfide Formation[16]

Disposal of gypsum drywall in landfills has been demonstrated to elevate hydrogen sulfide (H(2)S) concentrations in landfill gas. H2S is a pungent, highly toxic gas, and its formation in Municipal Solid Waste (MSW) landfills is similar to Construction and Demolition (C&D) landfills in that a sulfate source, carbon source, anaerobic conditions, moisture, pH and temperature must be present.

The diversion of gypsum drywall from disposal has been recommended as a measure to prevent H(2)S formation in landfills. In some cases, landfills have instituted bans on the disposal of drywall (except for small amounts). A variety of recycling markets have been developed for gypsum drywall, including for purposes such as agricultural soil amendments and manufacture of new drywall, so the increase in the diversion of drywall for recycling would be expected to reduce the amount of drywall that is deposited into landfills. As with any recycled product, the ability to effectively recycle a waste component depends on market demand, the cost of virgin materials or materials being replaced by the recycled product, disposal costs, transport costs, and other factors.

At the time of this PCR publication, there are no consensus-based quantitative methods for estimating H(2)S gas attributable to gypsum drywall in landfills. As such, EPDs shall include the following language in Section 9.6, “Disposal of gypsum drywall in landfills has been shown to elevate hydrogen sulfide (H(2)S) concentrations in landfill gas, a problem with respect to odor, worker safety, and deleterious effects on gas-to-energy systems.”

8.3.2. Beneficial Reuse of Waste Gypsum

8.3.2.1. Cement and concrete[17]

Gypsum is used in the manufacture of cement to retard setting time, which allows for temporal flexibility in applications of concrete. Gypsum-enhanced cement is a best practice when mixing, transporting, placing and forming concrete. The amount of gypsum added to cement varies depending on other ingredients, which can include limestone, shells, and chalk or marl, all combined with shale, clay, slate, blast furnace slag, silica sand, and/or iron ore. After the cement is treated with high heat, the resulting “clinker” aggregate is first ground and then mixed with gypsum. Portland cement – a formulation – is the most common cement type in North America. The Minerals Education Coalition[18]

[16] Best Management Practices (BMPs) to Prevent and Control Hydrogen Sulfide and Reduced Sulfur Compound Emissions at Landfills that Dispose of Gypsum Drywall – EPA Office Research and Development (ORD) 2014

[17] “Cement” and “concrete” are related materials. Cement is a binding agent made from crushed limestone and water-slurried clay; Concrete is a building material created by mixing cement, water, sand, and pebbles.

[18] Minerals Education Coalition, Infrastructure and Construction Materials Guide — Gypsum,

explains, “Every ton of Portland cement requires 3-5% by weight of gypsum.” The United States Geological Survey (USGS) produces yearly Mineral Commodity Summaries[19]. Their 2024 gypsum summary notes, “Gypsum has no practical substitute in the manufacturing of Portland cement.”

In the same report, USGS acknowledges that recycling of gypsum panels from new construction takes place but that, crucially, the “amounts are unknown.” Use of recycled gypsum feedstock in cement production is identified as a potential end market for waste gypsum. A growing body of scientific literature is devoted to exploring the incorporation of recycled gypsum in cement and concrete. At this time, specific data on amounts of captured waste gypsum in the cement industry is not available.

8.3.2.2. LAND APPLICATIONS

In the United States and Canada, gypsum has been used as an agricultural soil amendment for more than 250 years. Early users sought the soft mineral – calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$) – as a fertilizer. Gypsum does provide the essential plant nutrients of calcium and sulfur. However, as an amendment considered more broadly, gypsum offers additional benefits potentially more valuable than its use as a fertilizer. Properly applied, gypsum improves both soil and adjacent water quality. For example, heavy clay soils especially benefit from gypsum’s use to promote soil aggregation, which aids plant emergence and water infiltration. Further, applied gypsum can mitigate soil acidity and aluminum toxicity. Both natural gypsum and flue gas desulfurization gypsum are used as agricultural amendments[20]. In areas where phosphorus runoff from agricultural fields to surface waters is problematic, many studies affirm that gypsum reduces phosphorus runoff to local watersheds[21].

Another source of gypsum for land applications is gypsum powder derived from paper-faced, clean scrap gypsum panels. In the United States, processors of gypsum for agricultural use generally rely on clean scrap gypsum panels rather than demolition gypsum, due to contamination concerns. The beneficial reuse of scrap gypsum panels as a soil amendment is prompting state agricultural Cooperative Extension offices to produce guidance on gypsum panel waste as a

https://mineralseducationcoalition.org/mining-minerals-information/guide-gypsum/ retrieved May 23, 2024

[19] United States Geological Survey, Mineral Commodity Summaries 2024 https://pubs.usgs.gov/periodicals/mcs2024/mcs2024.pdf. p. 87

[20] Liming Chen, Warren K Dick, (2011). Ohio State University Extension Bulletin 945, School of Environment and Natural Resources, The Ohio State University.

[21] Elkholm, P., Valkama, P., Jaakkola, E., Kiirikki, M., Lahti, K. and Pietola, L., (2012). Gypsum amendment of soils reduces phosphorus losses in an agricultural catchment. Agricultural and Food Science.

source of gypsum field use[22]. Additionally, the Construction and Demolition Recycling Association (CDRA) offers members significant guidance on processing and permitting for agricultural markets[23].

Formal and informal markets exist for agricultural use of waste gypsum. While larger processors of agricultural gypsum (derived from gypsum panel scrap) sell material to farmers nationally, it is widely acknowledged that many processors and distributors operate in informal, highly regional, and largely unregulated economies.

Transport aspects of agricultural gypsum processing primarily concern distances between demolition locales and the two recycle and reuse options: End-of-life calculations for the transport emission from Demolition Site to Construction and Demolition (C&D) and /or Recycling Facility should rely on primary data. In terms of transport energy footprint, analysis should note that the distance between demolition event and the gypsum scrap processor is likely significant. Currently, the United States lacks a robust number of gypsum processing facilities. For example, the Northeast Recycling Council's 2016 "Construction and Demolition Debris Market Study" states, "Gypsum that is recycled from Massachusetts facilities typically goes to a Pennsylvania facility [Denver, PA] where it is made into an agricultural product."[24]

8.4. Mandatory Additional Environmental Information

8.4.1. Regulated Hazardous Substances

Per Part A Section 8.4.1(ISO 21930:2017 Section 8.4.1), with additional guidance/clarification:

Regulated hazardous substances shall be reported in "EPD Content," Section 9.2.3.

The measurement of releases of dangerous substances from gypsum panels during use and installation is not relevant to the scope of this Part B.

8.4.2. Release of Dangerous Substances from Construction Products

Per Part A Section 8.4.2 (ISO 21930:2017 Section 8.4.2), with additional guidance/clarification:

The release of dangerous substances shall be reported in "EPD Content," Section 9.2.3.

---

[22] Wolkowski, R. P. (2000). Using Wallboard Waste for Crop Production. University of Wisconsin extension, Cooperative Extension 2003.
[23] https://www.cdrecycling.org/
[24] DSM Environmental Services, *2016 Construction and Demolition Debris Market Study*, prepared for the Northeast Recycling Council, 2017

9. EPD Content

9.1. Main Sections of an EPD

Per Part A, Section 9.1.

9.2. General Information

Per Part A, Section 9.2.

9.2.1. EPD Holder and General Product Information

Per Part A, Section 9.2.1.

9.2.2. Verification Information

Per Part A, Section 9.2.2, with reference to this Part B PCR.

9.2.3. Limitations, Liability, and Ownership

Per Part A, Section 9.2.3.

9.3. Product Information and Methodological Framework

Per Part A, Section 9.3.

9.3.1. Declared or Functional Unit

Per Part A, Section 9.3.1, with the following clarification:

Declared unit: 92.9 m^2 (1000 ft^2) of installed product
Functional unit: 92.9 m^2 (1000 ft^2) of installed product with an RSL of 75 years
Mass per declared/functional unit: Since this PCR uses an area-based declared / functional unit, the thickness and mass of the product(s) shall be indicated as per Table 9.
Product Reference Service Life: 75 years

Table 9. Functional / declared unit properties

Name	***Value***	***Unit***
Functional / declared unit	92.9 (1000)	m^2 (ft^2)
Mass	To be declared	kg
Thickness	To be declared	cm

9.3.2. Product Specifications

Per Part A, Section 9.3.2, with the additional reporting requirements from Section 1.1 and below in Table 10.

Table 10. Gypsum Panel Specifications

Label	Instructions	Option	
	Pick one	09 28 16	Glass-Mat Faced Gypsum Backing Boards

Label	Instructions	Option	
CSI/ Masterformat		09 28 19	Fibered Gypsum Backing Boards
		09 29 00	Gypsum Board
		06 16 43	Gypsum Sheathing
UNCPC	List code	314	Boards and Panels
UNSPSC	List code (if applicable)	30161509	Gypsum Board
Product class and standard	Pick one	Gypsum Board (ASTM C1396)	
		Glass Mat Gypsum Panels (ASTM C1658)	
		Fiber-Reinforced Gypsum Panels (ASTM C1278)	
		Glass Mat Gypsum Substrate for Use as Sheathing (ASTM C1177)	
		Coated Glass Mat Water-Resistant Gypsum Backing Panel (ASTM C1178)	
		Factory-Laminated Gypsum Panel Products (ASTM C1766)	
		Other	
Product subcategory	Pick all that apply	Gypsum Wallboard	
		Gypsum Ceiling Board	
		Gypsum Sheathing	
		Exterior Gypsum Soffit Board	
		Water-Resistant Gypsum Backing Board	
		Gypsum Backing Board	
		Gypsum Lath	
		Gypsum Base for Veneer Plaster Base	
		Gypsum Shaftliner Board	
		Pre-decorated Gypsum Board	
		Gypsum Board for Manufactured Housing	
		Abuse-Resistant Gypsum Panel	
		Impact-Resistant Gypsum Panel	
		Glass Mat Interior Gypsum Panel	
		Glass Mat Water-Resistant Gypsum Panel	
		Glass Mat Shaftliner Gypsum Panel	
		Glass Mat Abuse-Resistant Gypsum Panel	
		Glass Mat Impact-Resistant Gypsum Panel	
Core type	Pick one	Regular	
		Type X	
		Type C	
		Other	
Facer type	Pick one	Paper	
		Glass-mat	
		Unfaced	

Label	Instructions	Option	
Recycled Content	Provide percentage of representation (Examples for each material are shown to the right)	Material	Percentage of representation (required)
		Recycled paper (pre-consumer)	15%
		Recycled paper (post-consumer)	5%
		Recycled glass	0%
		Recycled gypsum core	0%
Options	Pick all that apply	Foil backing	
		Mold-resistant	
		Moisture-resistant	
		Abuse-resistant	
		Impact-resistant	

9.3.3. Product Material and Component Information

Per Part A, Section 9.3.3, with the following clarification:

A description of the main product components or materials that make up the product shall be given in mass percentage. Components to be reported include:

- Gypsum core
- Paper facer
- Glass-mat facer

Packaging materials, if applicable, shall be reported per Part A Section 9.3.3.

Biogenic carbon content of the construction product leaving the factory gate and any accompanying packaging shall be declared as per Part A, Section 9.3.3, Table 10.

Regulated hazardous substances and/or the release of dangerous substances from Part A, Section 9.3.3 should be declared.

9.3.4. EPD Representativeness

Per Part A, Section 9.3.4.

9.3.4.1. Scope of EPD

Per Part A, Section 9.3.4.2.

The scope of the EPD with respect to the life cycle stages includes:

- Cradle to gate (A1 – A3)
- Cradle to gate with options:
  - Cradle to installation (A1 – A3. A4. A5)
  - Cradle to gate with end of life (A1 – A3, C1 – C4)
- Cradle to grave (A1 – A3, A4, A5, B1 – B7, C1 – C4)

9.3.4.2. EPD Data Specificity

Per Part A, Section 9.3.4.2.

9.3.4.3. EPD Averaging

Per Part A, Section 9.3.4.3.

9.3.5. Manufacturing Information

Per Part A, Section 9.3.5.

9.3.6. Software, Data Sources, and Data Quality

9.3.6.1. Software and Databases

Per Part A, Section 9.3.6.1.

9.3.6.2. Data Sources

Per Part A, Section 9.3.6.2, Table 11, with the following additional requirements:

According to Section 7.1.9, EPDs shall disclose sources for the following background data:

- Electricity mixes (consumptive)
- Fuel sources
- Transportation mode (e.g. rail and truck)
- Raw material extraction/production
  - Gypsum ore
- Upstream product production
  - Glass mat
  - Gypsum paper

If specific data are used for any of these flows instead of average, generic data, they shall be identified as “specific data” in the “Inventory Dataset Name” column in Table 11.

Table 11. Data Disclosure Table (Example); based on Part A, Table 11

Material/ Process Category	**Module**	**Material/ Process Name**	**Inventory Dataset Name** *(Italicized examples to be replaced below)*	**Dataset Geographic Region**	**Year Dataset Represents**	**Reference**
Material/ Product	A1	Gypsum ore	*Specific data (include name)*			
	A1	Gypsum paper	*Specific data (include name)*			

Material/ Process Category	Module	Material/ Process Name	Inventory Dataset Name *(Italicized examples to be replaced below)*	Dataset Geographic Region	Year Dataset Represents	Reference
	A1	Gypsum glass mat	*Specific data (include name)*			
Transportation	A2	Rail	*Transport, freight train, diesel*			
	A2	Truck	*Transport, freight, lorry >32 metric ton, EURO4*			
Energy	A3	Electricity	*Electricity, consumption mix, medium-voltage,*			
	A3	Natural Gas	*Heat, district or industrial, natural gas {RoW}| heat production, natural gas, at industrial furnace >100kW*			

9.3.6.3. Data Quality

Per Part A, Section 9.3.6.3, with additional documentation requirements from Section 7.1.9 of this PCR.

9.3.7. LCA Discussion

9.3.7.1. Allocation Procedure

Per Part A, Section 9.3.7.1.

9.3.7.2. Cut-off Procedure

Per Part A, Section 9.3.7.2.

9.3.8. Renewable Electricity

Per Part A, Section 9.3.8.

9.4. Technical Information and Scenarios

9.4.1. General Information

Per Part A, Section 9.4.1, with additional clarification:

This PCR specifies default, conservative parameters for installation, use, and end of life scenarios to ensure comparability and consistency of results. If a manufacturer wishes to define their own scenario(s), they shall be based on primary data.

9.4.2. A4, Transport Scenario

Per Part A, Section 9.4.2, with additional clarification and requirements in Table 12:

Table 12. Transport to the Building Site (A4)

Transport / Vehicle Type, incl emission class	*Description of transport*	*Fuel type*	*Fuel efficiency, l/100km*	*Distance, km*	*Capacity utilization (including empty runs, mass based)*	*Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)*	*Gross density of products transported, kg/m3*	*Weight of products transported (if gross density not reported), kg*
Tractor-trailer truck	From manufacturing site to DC	Diesel	35	448	Empty backhaul	=1	(from declared/ functional unit properties)	(from declared/ functional unit properties)
Rail	From manufacturing site to DC	Diesel	3	208		=1	(from declared/ functional unit properties)	(from declared/ functional unit properties)
Single unit truck	From DC to construction site	Diesel	25	40	Empty backhaul	=1	(from declared/ functional unit properties)	(from declared/ functional unit properties)

9.4.3. A5, Installation Scenario

Per Part A, Section 9.4.3, with additional clarification and requirements in Table 13.

Table 13. Installation into the Building/Construction Work (A5)
Default assumptions of 10% installation scrap should be used for all product systems unless otherwise justified.

Name	*Value*	*Quantity per DU/FU*
Installation scrap rate	10%	%
Lightweight Ready Mixed (*interior applications only*)	27.4	kg
	23.6	L
Conventional Ready Mixed (*interior applications only*)	41.2	kg
	25.1	L
Joint tape (370 feet per FU) (*interior applications only*)	0.90	kg
Screws (1,250 per FU) (*all applications*)	2.70	kg
Ancillary products (state)	Based on primary data	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	Calculated based on functional unit	kg
Total packaging waste materials resulting from on-site waste processing (default assumption: sent to landfill)	Based on primary data	kg
Plastics	Based on primary data	kg
Metals	Based on primary data	kg
Pulp	Based on primary data	kg
Total waste materials resulting from on-site waste processing (sum of product loss and packaging waste) (default assumption: sent to landfill)	Based on primary data	kg
Biogenic carbon contained in packaging	Based on primary data	kg CO_2

9.4.4. B1-B5, Use Scenario

Per Part A, Section 9.4.4, with additional clarification and requirements in Table 14.

Table 14. Reference Service Life

Name	Value	Unit
RSL	75	years
Declared product properties (at the gate) and finishes, etc.		Units as appropriate
Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes)		Units as appropriate
An assumed quality of work, when installed in accordance with the manufacturer's instructions		Units as appropriate
Indoor environment, (if relevant for indoor applications), e.g. temperature, moisture, chemical exposure)		Units as appropriate
Use conditions, e.g. frequency of use, mechanical exposure.		Units as appropriate
Maintenance, e.g. required frequency, type and quality of replacement components	0	Units as appropriate

9.4.5. B6-B7, Use Scenario

Not relevant to the scope of this PCR.

9.4.6. C1-C4, End-of-Life Scenario

Per Part A, with the following clarification in Table 15.

Table 15. End of Life (C1-C4)

Name		Value		Quantity per DU/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	Declared/Functional unit mass		kg
	Landfill	Declared/Functional unit mass		kg
	Recycling/Reuse	Declared/Functional unit mass		kg
Disposal (specified by type)	Product or material for final disposal	Declared/Functional unit mass		kg
Removals of biogenic carbon (excluding packaging)		Primary data		kg CO_2

9.5. Environmental Information from LCA

Per Part A, Section 9.5.

9.5.1. Results from LCIA

Per Part A, Section 9.5.1 for each reported information module.

9.5.2. Results from LCI

9.5.2.1. Resource Use and Water

Per Part A, Section 9.5.2.1 for each reported information module.

9.5.2.2. Waste and Output Flows

Per Part A, Section 9.5.2.2 for each reported information module.

9.5.2.3. Carbon Emissions and Removals (if applicable)

Per Part A, Section 9.5.2.3 for each reported information module.

9.5.3. Interpretation

Per Part A, Section 9.5.3.

9.6. Additional Environmental Information

Per Part A, Section 9.6, with additional requirements/guidance from Section 8.3.

9.6.1. References

Per Part A, Section 9.6.1, with the following additional references included in the EPD.

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.

Authors: 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.

9.6.2. H_2S Formation

The following language shall be included in an EPD published under this PCR and shall not be modified in any way:

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 H2S 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.

9.6.3. Recycling and Beneficial Reuse

The following language may optionally be included in an EPD published under this PCR. If included, the following statements shall be included in their entirety and shall not be modified in any way:

Cement and Concrete:
Gypsum is used in cement to delay setting time, providing flexibility in concrete applications. The amount of gypsum varies with other ingredients, such as limestone and clay. Portland cement, the most common type in North America, contains 3-5% gypsum by weight. Gypsum is essential in cement production, with no practical substitutes. Though recycling gypsum from new construction is acknowledged, the quantities are unknown, and it is a potential market for waste gypsum.

Land Applications:
Gypsum has been used in North American agriculture for over 250 years, providing calcium and sulfur to plants and improving soil and water quality. It benefits clay soils, reduces soil acidity and aluminum toxicity, and decreases phosphorus runoff. Clean scrap gypsum panels are preferred over demolition gypsum for agricultural use due to contamination concerns. Both formal and informal markets exist for agricultural gypsum, with transport emissions from demolition to recycling facilities being a significant consideration.

10. Project Report

10.1. Project Report

Per Part A, Section 10.1 (ISO 21930, Sections 10.1 and 10.3).

10.2. LCA-Related Elements of the Project Report

Per Part A, Section 10.2 (ISO 21930, Section 10.2).

10.3. Rules for Data Confidentiality

Per Part A, Section 10.3 (ISO 21930, Section 10.3).

10.4. Documentation of Additional Environmental Information

Per Part A, Section 10.4 (ISO 21930, Section 10.4).

10.5. Data Availability for Verification

Per Part A, Section 10.5 (ISO 21930, Section 10.5).

If third party audited data is used for facility emissions, the audit report shall be provided to the verifier during the review process.

Per Section 7.2.7, tests that determine the carbon content in biogenic materials and fuels shall be provided to the verifier.

11. EPD Verification and Validity

Per Part A, Section 11 (ISO 21930, Section 11 and ISO 14025), with the following additions:

EPD calculations completed by software systems are permitted provided the software has been verified per similar procedures as verifying an EPD. The process used to verify the software calculations should be publicly accessible and referenced from the EPD.

When a product specific EPD is aligned with an industry-wide average EPD, the following additional item is required:

In order to evaluate the consistency of results between product specific EPDs and industry-wide average EPDs either:

- the same LCA modeling software and version, background data set, and characterization model shall be used to create the EPD; or
- the LCA modeling software and version shall test representative samples of the regionally specific industry-wide average data and include in the EPD a report of the maximum percent difference for environmental impact categories: global warming potential, acidification potential, ozone depletion potential and smog creation potential. If a different LCA data set, tool, or characterization model is selected, it shall be used to calculate environmental indicators for a sample of representative cements taken from the published industry-wide average LCA report. The variation of results produced by the selected LCA modeling software and version, compared to the published environmental indicators in the industry-wide EPD shall be reported as a maximum percent variation for GWP 100, AP, EP or POCP. This is to provide transparency on the variability of results that stem from background data and models.

ANNEX: END OF LIFE CONSIDERATIONS

FATE OF GYPSUM PANEL WASTE

In Section 7.1.7.5, module C4 (waste disposal) assumes that gypsum panels are disposed of in an appropriate construction and demolition landfill. However, waste management is highly regional and reflects municipal, state, and national regulations. A future, fulsome LCA may identify and attempt to quantify the fate of gypsum waste streams at end of life.

Understanding fate of gypsum waste streams relies on understanding informal markets[25] or extra-regulatory activity. These informal markets can include the trading or passing on of excess gypsum panels, especially partial panels. Efficient sharing of small amounts of gypsum panel cut-offs between craft workers reflects the very heart of an informal market. Panels donated to several types of re-use organization including groups like Habitat for Humanity and other nonprofit groups who accept construction material for sale or donation, often with the primary goal of diverting waste away from landfills.

Another type of informal market concerns illegal and/or extra-regulatory disposal / dumping of gypsum panels, often along with other construction materials. Illegal dumping includes:

- Using landfills but not through documented waste management protocols;
- Dumping to vacant lands / public lands / rural expanses typically at night or in remote places, sometimes called *fly dumping*;
- Dumping to inland waterways, often at night or in remote areas; and
- Dumping to marine waters, sometimes by boat.

Some illegal dumping involves actors unwilling to pay hauling fees or tipping fees to place C&D materials in an appropriate landfill.

Assigning numbers to these hidden processes that characterize informal markets is perennially difficult. Quantifying a gypsum volume here is even more elusive. Still, these end-of-life scenarios for gypsum panels can be acknowledged.

[25] Informal markets, part of informal economics, consist of activities with market value or market implications but are neither formally registered nor tracked with traditional economic measures and/or proxies. While most informal markets are documented and studied, due to the need for reform of these markets, their proportion of a country's economy varies widely: The International Monetary Fund estimates that on average, an informal market can represent 35 percent of GDP in low- and middle- income countries versus 15 percent in advanced economies.

The size of the US informal economy is estimated to be 7.3% of GDP (2022) (approximately $1.725 billion), according to the Quarterly Informal Economy Survey by World Economics (London).

Gypsum Recycling and Beneficial Reuse

The information contained in this section serves as background information and is not relevant to the end-of-life scenario defined in Section 7.1.7.5 of this PCR.

In the United States, concerns about legacy asbestos and lead paint create a strong preference for post-consumer recycled gypsum derived from "clean scrap" i.e., new construction cut offs. In Canada, gypsum panels manufactured after 1900 are considered acceptable for closed-loop recycling, if these panels are carefully deconstructed before transport to the processing facility.

Generally, in North America, gypsum panels intended for beneficial reuse as a soil amendment or recycling as a cement or gypsum panel feedstock, must be processed. Processing includes mechanical grinding and screening until the paper is removed from the gypsum core; processing of the core material continues until the gypsum reaches a particle size appropriate to a specific end market. See ASTM C1881-20 *Standard Guide for Closed-Loop Recycling of Scrap Gypsum Panel Products* for processes associated with preparing post-consumer gypsum panels for various end market uses. Currently, the environmental impacts associated with production of post-consumer gypsum feedstocks and soil amendments have not been measured.

A materials recovery facility (MRF) can be a collection point for gypsum panels and other materials prior transport to a processor or landfill. Unless clean scrap is source separated at the jobsite, placed in a dedicated container, and directly transported for processing, the recovery rate of gypsum tends to be low. Mixing construction and demolition (C&D) materials at any point in the collection process usually lowers recovery rates across multiple waste streams due to cross contamination. The low recovery rate associated with mixed C&D loads is clear, for example, in Massachusetts where landfilling clean scrap gypsum panels has been banned since 2011. A 2022 report, *Statewide Bulky Waste Characterization Study*, issued by the Massachusetts Department of the Environment (MassDEP), showed that numerous materials—including drywall—could have been recovered had these materials been removed from the waste stream earlier. Similarly, a 2016 MassDEP *Construction and Demolition Market Study,* noted that only 61 tons of clean scrap gypsum received at MRFs was source separated. Source separation is a first step in any type of gypsum recovery process. It should occur at the job site as responsibility of the construction entity. Responsibility for keeping gypsum panel scrap segregated from other jobsite waste and debris, such as food and drink containers, metal fasteners, and plastic or other wrappings, can be assigned to trade workers or a separate and distinct cleaning entity as noted in the construction contract. As a result, of the 22,920 tons of scrap collected, only 811 tons were recycled, a 4% recovery rate. Also noted in this Massachusetts-focused report, most of that clean scrap was recycled in a Pennsylvania facility more than 350 miles away from the populous city of Boston. This transport distance poses an additional environmental impact created by the lack of a processor in Massachusetts.