DEQ Housing Guide for Drawings and Specifications

In order to satisfy "Requirement 4: Reduce embodied carbon of new building materials by 10%" for DEQ's Low Embodied Carbon Housing Program, project teams must meet one of the four pathways outlined in the Low Embodied Carbon Compliance Guidebook.[1] These pathways offer different methods for project teams to demonstrate the required 10% reduction at the building scale.

This document outlines how a project team can ensure their low embodied carbon design intentions become documented requirements for construction. Communicating lower embodied carbon design requirements via specifications and/or plan notes to the construction team can help ensure reductions are realized. Ultimately, builders must install the relevant products and system to comply with the program.

How do I convey low embodied carbon design measures?

Many factors might influence how a project communicates or designs low embodied carbon requirements. The main drivers are both project size and bid structure:

- For smaller residential projects that are not issuing specifications, lower carbon products or design choices may be depicted in the **design contract drawings** (typically in the structural general notes, design details, or schedules).
- For larger, multi-family residential projects that are competitively bid and issue specifications, these contractual documents are often the best avenue to convey embodied carbon requirements. Lower carbon products can be included by noting a basis of design product or list of products that meet the project requirements, or more flexibility can be offered by writing performance requirements in the form of Global Warming Potential Targets (discussed in the next section). Embodied carbon requirements should be coordinated across both the **construction documents** and the **specifications**.

DEQ Low Embodied Carbon Housing projects may need to use drawings and specifications to:

- Show that some design approach (foundation type, salvaged cladding) has been used
- Show that a low carbon product type or specific product has been selected and installed
- Require that products comply with maximum embodied carbon intensities (called Global Warming Potential targets) using acceptable Environmental Product Declarations
- Incorporate performance-based metrics that enable low carbon solutions for certain materials (e.g. specifying shrinkage limits as opposed to water/cement ratios or more days to strength for ready-mix concrete)

Early collaboration with builders is critical

Having early discussions about embodied carbon expectations greatly benefits the project's capacity to reduce embodied carbon effectively and keep costs down. Typical embodied carbon reductions by material type and their associated cost premiums are shown in Figure 1.

Figure 1. Excerpt from RMI's *Reducing Embodied Carbon in Buildings: Low-Cost, High-Value Opportunities*[2] depicting the potential effect of each material can have on building level embodied carbon reductions in A1-A3 emissions and an estimated associated cost premium.

KEY TERMS

Low Embodied Carbon Compliance Guidebook

This guidebook contains all the relevant requirements for achieving "Requirement 4: Reduce embodied carbon of new building materials by 10%" as part of DEQ's Low Embodied Carbon Program for Housing.

Specifications

Specifications provide additional information for general contractors and subcontractors for how specific building materials should be procured, as well as their aesthetic and functional attributes. This contract document supports the alignment of a building with the design intent, which, for lower-carbon designs, is key for achieving embodied carbon targets.

Global Warming Potential

The potential climate change impact of a product or process as measured by a life cycle assessment (LCA). GWP is reported in units of carbon dioxide equivalent (CO_2e) and is the agreed upon metric for tracking embodied carbon.

REFERENCES

1. Carbon Leadership Forum and Oregon DEQ (2025). Low Embodied Carbon Compliance Guidebook. V1.
2. Matt Jungclaus, Rebecca Esau, Victor Olgyay, and Audrey Rempher, *Reducing Embodied Carbon in Buildings: Low-Cost, High-Value Opportunities*, RMI, 2021.

Baseline Global Warming Potential

The baseline global warming potential (GWP) for a product represents the **industry-average greenhouse gas emissions** in units of $kgCO_2e$ per declared unit for construction materials manufactured in North America, as documented in CLF's 2025 Material Baselines Report.[3] Baseline GWP values in DEQ's program will be the point of comparison for any product seeking to prove their footprint is lower than an average product. Some examples of GWP Baselines are as follows:

- Baseline GWP (A1-A3) of **300 $kgCO_2e/m^3$** for medium weight CMU
- Baseline GWP (A1-A3) of **753 $kgCO_2e$/metric ton** for fabricated rebar

Finding a product that falls *at* these GWP Baseline values is not enough to claim an embodied carbon reduction in this program. Applicants must prove that installed products collectively demonstrate a reduction *below* baseline values.

Global Warming Potential Targets

GWP targets are an optional method to convey a performance target **better than the baseline GWP** for a product. GWP targets indicate the allowable $kgCO_2e$ per declared unit of material that will allow the product to meet the target percent reduction from the baseline.

GWP targets are a useful way to translate a cumulative reduction goal into product-level targets, but are not required. Projects can decide which materials to pursue reductions for as long as the overall subset of products complies.

If you are seeking a **X% reduction** from a Baseline GWP for a product, a GWP target can be calculated using the following formula:

$$GWP\ target = GWP\ baseline \times (1 - X\%)$$

For example, if I am hoping to achieve a 20% reduction for medium weight CMU,

$$GWP\ target_{CMU} = 300 \times (1 - 0.2) = 240\ kgCO_2e/m^3$$

The table in Appendix A of the Low Embodied Carbon Compliance Guidebook[4], includes reference GWP baselines and sample targets calculated indicative of using Pathway 1 and 2 for compliance.

Pathway		Table of CLF's Baseline Values (kgCO2e/ declared unit)			Target Value (kgCO2e/ declared unit)		Declared unit
1	2	Product category	Product type	Baseline GWP	Pathway 1 (80% baseline)	Pathway 2 (89% baseline)	Declared Unit
	X	Cement	Masonry cement (mortar)	587	470	522	metric ton (tonne)
X	X	Ready-mix	2500 psi(17.2 Mpa), Normalweight	235	188	209	m3
X	X	Ready-mix	3000 psi (20.7 MPa), Normalweight	261	209	232	m3

Figure 2. Appendix A. Excerpt from Appendix A of the Low Embodied Carbon Compliance Guidebook depicting GWP baseline and recommended GWP targets to comply with Pathways 1 and 2.

EPDs are required to claim reductions from the baseline GWP

Suppliers must provide an environmental product declaration (EPD) to prove their product is below the baseline GWP to count towards the DEQ program requirements.

Strategies for reducing the embodied carbon of a product can vary by material and facility. EPDs help manufacturers disclose the unique impacts of their products to customers and can also help them understand where to make targeted improvements to their product to reduce carbon. To learn more about EPDs, read our II. Environmental Product Declaration 101: Housing.

KEY TERMS

Baseline GWP

Typical cradle to gate (A1-A3) embodied carbon value for a specific product type, measured in kilograms of carbon dioxide equivalent (kgCO2e) per declared unit.

GWP Target

A target Global Warming Potential that translates a desired reduction from a GWP Baseline into a target GWP value that products aim to fall below.

REFERENCES

3. Waldman, B., Habchi, R., and Palmeri, J. (2025). 2025 CLF North American Material Baselines Report. Carbon Leadership Forum.
4. Carbon Leadership Forum and Oregon DEQ (2025). Low Embodied Carbon Compliance Guidebook. V1.

Embodied Carbon Strategies in Design Drawings

The simplest approach to expressing low carbon design measures is to design and document relevant systems, materials or products in the project's design drawings, and then work to match those products and systems through purchasing and installation.

In this approach, the lower-carbon building systems, materials or products chosen should be called out in the drawings. **Figure 3** shows an example of how an architectural detail may show the ground floor system, cladding and insulation type which align with design strategies rewarded in Pathway 3 - Prescriptive Checklist. **Tables 1 & 2** show examples of tables that could be used to incorporate cement or GWP targets for concrete, aligned with Pathways 1, 2 and 3, as noted.

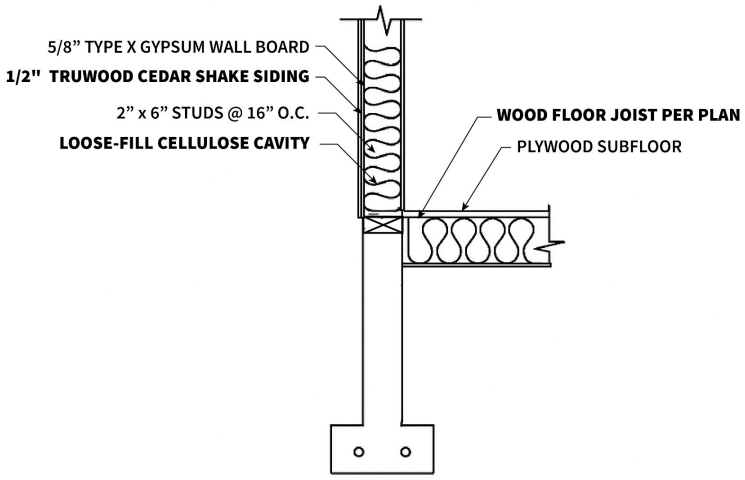

Figure 3. Architectural Details. Sample detail depicting low carbon details **in bold** including: loose-fill cellulose insulation, engineered wood siding, and timber floor joist over crawl space system, showing a few strategies from Pathway 3.

Table 1. Ready-Mix Concrete - GWP Targets for Pathway 1

Element	Compressive Strength	Min Days to Strength	Exposure Class				Maximum w/c ratio	Max Aggregate Size	Target Air Content	GWP Target Pathway 1
	(psi)		F	S	W	C		(in)	(%)	($kgCO_2e/m^3$)
Footings	4000	56	F0	S0	W0	C0	-	1 1/2	-	281
Basement Walls	5000	28	F2	S0	W1	C1	0.45	3/4	6	309
Interior SOG	3000	56	F0	S0	W0	C0	-	1	-	209

Notes

1. Concrete compressive strength must meet the requirements in Table 1, with a maximum **Global Warming Potential** as indicated in the GWP Target column.

Table 2. Ready-Mix Concrete - Cement Limits for Pathway 3

Element	Compressive Strength	Min Days to Strength	Exposure Class				Maximum w/c ratio	Max Aggregate Size	Target Air Content	Cement Limit Tier 2
	(psi)		F	S	W	C		(in)	(%)	(lbs/cy)
Footings	4000	56	F0	S0	W0	C0	-	1 1/2	-	375
Basement Walls	5000	28	F2	S0	W1	C1	0.45	3/4	6	464
Interior SOG	3000	56	F0	S0	W0	C0	-	1	-	305

Notes

1. Concrete compressive strength must meet the requirements in Table 2, with a maximum **cement content** as indicated.

Tables 1 and 2. Structural General Notes examples. Table 1 presents a sample showing concrete GWP targets for Pathway 1, though could be adapted for Pathway 2. Table 2 presents cement limits aligned with Pathway 3, which could be adapted for Tier 1 or 2. More discussion of flexible requirements for concrete is covered on Page 5. Adapted from the NCSEA performance-based concrete spec guidance document.[5] ***NOTE: These samples do not constitute professional advice, and should be incorporated at the discretion of professionals on the design team.***

KEY TERMS

NCSEA

The National Council of Structural Engineers Associations (NCSEA) Sustainable Design Committee published a guidance document[5] for performance-based concrete specifications and the format in which they should be communicated on the construction documents.

REFERENCES

5. Lyons, M., Roberts, K., et. al. (2024). 2024. *Performance-Based Concrete Specification Guidance: Concrete Class Table*. NCSEA Sustainable Design Committee.

Embodied Carbon Strategies in Project Specifications

Project specifications are detailed guidance documents that work alongside drawings to provide information about the how a project should be built and what kinds of products should be used. In the US, Construction Specification Institute (CSI)'s Masterformat divisions are commonly used to organize and convey design information, beginning with Division 01 that reflects General Requirements, and then Divisions 02-49 that covering all product sections.

Given their contents related to materials, installation, and submittals, specifications are an excellent method to convey low carbon design intent - especially for performance requirements. Specifications are often used to convey different levels of embodied carbon requirements:

1. **Requiring Environmental Product Declarations**
   Example Intent: For each concrete product used on the project, the GC must provide acceptable EPDs, that are third-party verified, unexpired, and specific to the product and facility where it was manufactured.

2. **Requiring that products comply with GWP targets for certain materials**
   Example Intent: All reinforcing bar products used on the project must have a GWP (A1-A3) of less than 854 kgCO_2e/metric ton as demonstrated by an acceptable EPD

3. **Performance-based metrics for certain materials (e.g. ready-mix concrete)**
   Example Intent: Permitting 5000 psi normal weight concrete at 56 days for concrete walls

As part of this program, we are providing a **Low Carbon Housing Sample Specification Package** which includes example language that offer a starting point for teams seeking to implement low embodied carbon requirements on their projects. The samples offered are specifically for Pathway 1, but the logic could be adopted or extended to be used for Pathway 2. ***NOTE: These specification samples do not constitute professional advice, and should be incorporated at the discretion of professionals on the design team.***

Table 3. Divisions included in Low Carbon Housing Sample Specification Package (Pathway 1)

Division 1	Section 018113	Sustainable Design Requirements
Division 3	Section 033000	Cast-in-Place Concrete
Division 7	Section 072100	Thermal Insulation
Division 9	Section 093013 Section 096500 Section 096800	Ceramic Tile Resilient Flooring Carpeting

Division 1 Specifications

Division 1 specifications typically include high level goals and definitions. Our sample Division 1, Section 018113 - Sustainable Design Requirements includes key definitions, submittal requirements, procedures for sourcing, and low embodied carbon definitions. The other division specs refer back to Division 1.

5. Global Warming Potential Baseline: Typical cradle to gate (A1-A3) embodied carbon value for a specific product type, measured in kilograms of carbon dioxide equivalent (kgCO2e) per declared unit.
6. Global Warming Potential Target: A Global Warming Potential performance value that translates a desired reduction from a GWP Baseline into a target GWP value that products aim to fall below.
7. Reduction Claim: A covered product where an Actual GWP is being used to show a percent reduction from Baseline GWP as part of the Embodied Carbon Reporting Form submission.

Figure 3. Excerpt of definitions from Low Carbon Housing Sample Specification Package, Division 1 Section 018113.

KEY TERMS

Construction Specifications Institute (CSI)

A United States based national association formed by more than 6,000 construction industry professionals. The association's Masterformat classification system is the AEC industry gold standard for organizing and communicating specifications.

TIPS

Low Carbon Housing Sample Specification Package

This package provides guidance for submittal requirements related to Pathway 1 DEQ's Low Embodied Carbon Housing Program. These include sample requirements for environmental product declarations (EPDs), baseline GWPs and GWP targets for key covered products. *These specification samples do not constitute for professional advice, and should be used at the discretion of the design team.* These were adapted from CLF's Model Embodied Carbon Specifications.[6]

REFERENCES

6. Waldman, B., Habchi, R., and Palmeri, J. (2025). 2025 CLF North American Material Baselines Report. Carbon Leadership Forum.
7. Rerick, L., Lambert, M. Palmeri, J. (2025). Model Embodied Carbon Specifications. Carbon Leadership Forum, University of Washington Life Cycle Lab, Washington State Department of Commerce.

Division 03 Concrete Specifications

Low carbon concrete is a significant opportunity for project teams across Oregon. Concrete EPDs are available in some but not all parts of Oregon, which can help with compliance for Pathways 1 and 2. Concrete EPDs are required in policies for the Oregon Department of Transportation, City of Portland, and City of Eugene. Pathway 3 also rewards project for concrete mixes that limit their cement use per strength class.

Low embodied carbon requirements for concrete are best communicated via **performance specifications.** Performance specifications indicate a desired *design outcome* if a concrete mix is required, but it is up to the supplier how they meet that requirement. (*i.e. GWP target, shrinkage limits).*

In the DEQ Low Carbon housing program, performance requirements in the form of GWP targets are acceptable to comply with Pathways 1 and 2. For simple examples depicting these requirements integrated into structural design general notes, see Tables 1 and 2 on page 3.

Sample Performance Specification for Concrete

Figure 4 is an example of a performance-based approach to ready-mix concrete and rebar specifications that specify what is required for structural performance by element. Note that:

- For the elements that do not affect construction schedule or structural performance, the tables allows additional time (56 days or more) for the mixes to come to strength.
- Water-cement ratios only apply to elements required by the element's exposure class.
- The GWP Baseline is based on the CLF 2025 Material Baseline report, with full sources documented in the DEQ Embodied Carbon Reduction Form
- The GWP Target represents a 20% reduction from the baseline value, as required to comply with Pathway 1 of the DEQ requirements.

1. For products where a reduction claim is made, provide an Acceptable Environmental Product Declaration (EPD) that documents the following:
   a. Actual Embodied Carbon: Product's GWP value as listed on EPD in $kgCO_2e$ per Declared Unit.
   b. System Boundary: Product Stage A1-A3.
   c. Declared Unit: m^3
   d. Product Category Rule (PCR): PCR used to create EPD, as listed on EPD.
2. Global Warming Potential Baselines: As expressed in kg CO_2e per Declared Unit.

Concrete Class and Strength	Baseline Global Warming Potential ($kgCO_2e$ per m^3)
2500 psi(17.2 Mpa), Normalweight	235
3000 psi (20.7 MPa), Normalweight	261
3500 psi (24.1 MPa), Normalweight	289
4000 psi (27.6 MPa), Normalweight	316
4500 psi (31.0 MPa), Normalweight	351
5000 psi (34.5 MPa), Normalweight	386
5500 psi (37.9 MPa), Normalweight	397
6000 psi (41.4 MPa), Normalweight	408
7000 psi (48.3 MPa), Normalweight	448
8000 psi (55.1 MPa), Normalweight	487
3000 psi (20.7 MPa), Lightweight	518
4000 psi (27.6 MPa), Lightweight	575
5000 psi (34.5 MPa), Lightweight	632

   a. All Baseline GWP values shall be based on the required compressive strength of concrete as listed in the Contract Documents.

Figure 4. Excerpt from Low Carbon Housing Sample Specification Package, Division 3 Section 033000: Cast-in-place Concrete.

TIPS

Low Carbon Housing Sample Specification Package

This package provides guidance for submittal requirements related to Pathway 1 DEQ's Low Embodied Carbon Housing Program. These include sample requirements for environmental product declarations (EPDs), baseline GWPs and GWP targets for key covered products. *These specification samples do not constitute for professional advice, and should be used at the discretion of the design team.* These were adapted from CLF's Model Embodied Carbon Specifications.[6]

Other Material Specifications (07 and 09)

The Division 7 and 9 specifications focus on incorporating GWP targets for common insulation and flooring materials.

The sample specifications detail the submittals required to be provided by the contractor to the design team and the performance requirements for each product type. The design team should closely review the tables in the specifications and update with relevant values for Pathways 1 and 2 in order to comply with the program requirements.

Please note that the relevant values the design team chooses will likely vary from project to project as the values are meant to fit both the program requirements *and* the specific project characteristics and opportunities for reduction.

Division 07 - Thermal and Moisture Protection

The sample specifications for Division 7 include samples for sections 072100 - Thermal Insulation and 072119 - Foamed-In-Place Insulation. Similar requirements should be extended to include all specifications for all insulation products used on the project.

4. Global Warming Potential Targets: As expressed in $kgCO_2e$ per Declared Unit.

Insulation Type	Global Warming Potential Targets ($kg\ CO_2e$ per m^2@RSI-1)
Expanded polystyrene (EPS) Type I	2.02
Fiberglass board	4.02
Heavy density mineral wool board	5.46
Polyisocyanurate (Polyiso), aluminum foil facer	3.28
Polyisocyanurate (Polyiso), Glass-Fiber-Reinforced Cellulosic (GRF) facer	1.69
Polyisocyanurate (Polyiso), Coated Glass Facer (CGF)	2.36

Figure 5. Excerpt from Low Carbon Housing Sample Specification Package, Division 7 Section 072100: Thermal Insulation.

Division 09 - Flooring

The sample specifications for Division 9 include samples for sections 093000 - Tiling, 096500- Resilient Flooring, and 096813 - Carpeting. Similar requirements should be extended to include all specifications for all flooring products used on the project.

3. Global Warming Potential Targets: As expressed in $kgCO_2e$ per Declared Unit.

Carpet Flooring Types	Global Warming Potential Target ($kgCO_2e$ per m^2)
Broadloom carpet	8.1
Carpet Tile	7.5

a. Pursuing Pathway 1, the project has a goal to achieve a 20% embodied carbon reduction across the products covered by Pathway 1. For this reason, no individual product must meet the Global Warming Potential Targets in the above table. Instead

Figure 6. Excerpt from Low Carbon Housing Sample Specification Package, Division 9 Section 096500: Resilient Flooring.

TIPS

Low Carbon Housing Sample Specification Package

This package provides guidance for submittal requirements related to Pathway 1 DEQ's Low Embodied Carbon Housing Program. These include sample requirements for environmental product declarations (EPDs), baseline GWPs and GWP targets for key covered products. *These specification samples do not constitute for professional advice, and should be used at the discretion of the design team.* These were adapted from CLF's Model Embodied Carbon Specifications.[6]