Chapter 2 Definitions
Section 202 Definitions

Add new definitions as follows:

CRADLE-TO-GATE. Refers to construction product development activities associated with the product production stage and modules A1 through A3, in accordance with ISO Standards 14025 and 21930.

CARBON DIOXIDE EQUIVALENT (CO2e). A measure used to compare the impact of various greenhouse gases based on their global warming potential (GWP). CO2e approximates the time-integrated warming effect of a unit mass of a given greenhouse gas relative to that of carbon dioxide (CO2).

GLOBAL WARMING POTENTIAL (GWP). A measurement that combined the impact of the various greenhouse gases relative to an equivalent unit of carbon dioxide over a given period of time.

PRODUCT-SPECIFIC TYPE III ENVIRONMENTAL PRODUCT DECLARATION (EPD). Type III environmental product declaration (EPD) complying with the goal and scope for the production stage and modules A1 through A3 (also referred to as cradle-to-gate) requirements in accordance with ISO Standards 14025 and 21930 and be available in a publicly accessible database. The data must represent the impacts for a specific mix design and manufacturers across multiple facilities.

Chapter 19 Concrete

Section 1901 General
Add new section as follows:

1901.7 Embodied CO2e in concrete products. 100% of all concrete mixes, by volume, used in the building project's *primary structural frame*, *secondary members*, lateral force-resisting system, and foundations shall not exceed the values specified in Table 1901.7 based on the compressive strength of each individual mix, or comply with Equation 1901.7.1. Products must meet the documentation requirements of 1901.7.2.

Exceptions:
1. Precast, shotcrete, or auger cast concrete.
2. Projects less than 50,000 gross floor area.

Table 1901.7 CO2e Limits in Concrete Mixtures[a]

Procured compressive strength f'_c, psi at 28 days	Maximum kg/y^3(SI)	High-early strength Maximum kg/y^3 (SI)[b]	Lightweight concrete Maximum kg/y^3 (SI)[c]
2500	180	234	396

3000	200	260	396
4000	242	314	440
5000	295	384	483
6000	312	406	N/A
8,000	373	484	N/A
10,000	451	486	N/A

a: If a mix does not have a product-specific EPD, assume 200% of IW-EPD GWP.
b: High-early strength concrete achieves a compressive strength could achieve structural concrete quality within 24 hours to seven days.
c: Lightweight **c**oncrete contains *lightweight aggregate* and has an equilibrium density determined by ASTM C567.

1901.7.1 CO2e Weight Average Method - Project. Total CO2e (CO2Eproj) of all concrete placed at the building project shall not exceed the project limit (CO2Emax) determined using Table 1901.7 and Equation 1901.7.1.1.

Equation 1901.7.1

CO2Eproj < CO2Emax
where: CO2Eproj = ΣCO2En vn and CO2Emax = ΣCO2Elim vn
and
n = the total number of concrete mixtures for the project
CO2En = the global warming potential for mixture n per mixture EPD, kg/y^3
CO2Elim = the global warming potential limit for mixture n per Table 1901.7, kg/y^3
vn = the volume of mixture n concrete to be placed

1901.7.2 Documentation of Product CO2e. 100% of the concrete mixes, based on volume, must have a product-specific cradle-to-gate Type III EPD. Confirmation of the product's EPDs shall be provided to the code official prior to the certificate of occupancy.

Reason Statement:
Building operations and construction are responsible for 39% of today's global carbon emissions. About 11% of these emissions are embodied carbon emissions, the emissions associated with the creation of building materials and construction activities. Unlike operational emissions, which can be improved over the lifespan of a building through deep-energy retrofits and the decarbonization of the electric grid, embodied carbon emissions occur before a building is occupied and cannot be reduced over time. Therefore, addressing embodied carbon in the construction of buildings presents an urgent and valuable opportunity to reduce carbon emissions in Seattle.

As the Seattle energy code continues to improve building energy efficiency and the grid energy becomes cleaner, operational carbon emissions will be reduced, and embodied carbon will become a larger part of a building's total carbon emissions. The building code regulates the materials and products installed in buildings. Therefore the proposal is recommended for the concrete chapter of the building code.

Concrete is one of the most widely used materials in building construction and a primary contributor to embodied carbon in buildings. A 2020 case study analysis by RMI shows that simply by specifying concrete products with lower CO2e content, a commercial construction project's embodied carbon can be reduced up to 33%.

Construction professionals procure concrete in nearly every project. Ready-mix suppliers design concrete mixes for each project based on specific needs. However, the general components of concrete remain the same, with cement, sand and other aggregates, water, and additives varying as needed. Although each of concrete's constituent materials offers opportunities for reductions in embodied carbon, the high-carbon concrete is primarily driven by the manufacture of one key ingredient—ordinary Portland cement. Portland cement is the most common cementitious binder used in concrete mixtures in the U.S., and the U.S. cement industry is one of the most significant contributors to U.S.-borne emissions at 68.3 million metric tons (MMT) of CO2 eq. per year. The building construction industry's demand for concrete accounts for an estimated 51% of total Portland cement produced in the U.S.

Aligned Initiatives:
The cement and concrete industries have started adapting to this regulation. The Global Cement and Concrete Association set the goal of reducing emissions by 50% by 2030 and reaching net zero by 2050. However, progressing the timeline will support Washington and King County goals. The Washington State legislature has been very interested in embodied carbon policies like Buy Clean as they have funded additional research into the topic. The legislation and research have signaled to the market that these policies are of interest. The market has responded with innovative solutions, leading local architects and contractors to specify and procure lower-carbon concrete for select jobs.
Washington has been a leader in environmental product declaration development. Washington state has over 2,600 public listed and well over 1,200 in the Seattle region. One concrete professional notes that there are over 4,000 concrete EPDs in Seattle – not all are publicly listed. Sound Transit Authority has requirements for EPD and GWP reporting on their projects. However, based on insight from contractors requesting a higher strength GWP limit than what

NRMCA's industry-wide EPD offers, this proposal uses their approach to setting GWP limits for 10,000 psi and higher concrete.

Compliance:

Projects will be required to meet a weighted average of all the mixes to meet the industry-wide global warming potential (GWP) value for the Pacific Northwest region. The table lists the GWP cap for each strength as indicated by the industry-wide environmental product declaration (EPD), a survey of the ready-mix concrete industry's embodied carbon, as issued by the National Ready-Mixed Concrete Association (NRMCA.) In stakeholder meetings with contractors, engineers, architects, and concrete providers, they prefer a weighted average approach (1901.7.2), allowing flexibility to achieve an overall concrete GWP cap for the project. It should be noted that the concrete professionals were less interested in the proposal than the other stakeholders due to their ability to make carbon adjustments through a market-by-market approach.

Anticipated reporting requirements might include the weighted average of all concrete mixed and a summary table of concrete mix GWP and the calculation. In addition, Seattle may request that a plan for reporting material GHG emissions be provided at the time of permit.

Design, construction, and product manufacturers must work together to achieve and report the embodied carbon results. Architects will include the concrete mix global warming potential (GWP) requirements in project specifications, review the cutsheets as contractors select, and provide submittals for the designers to review. Contractors will work with concrete suppliers to identify concrete mixes products that meet the GWP values. With over 4,000 EPDs available from Seattle concrete providers, many of which meet the GWP limits proposed within.

Concrete Cost Data:

The cost impact of the embodied carbon proposal has been shown to be cost-neutral to design teams. The optimizations needed to produce compliant concrete mixes exist, and the innovation is expanding. Reduced carbon concrete can be achieved primarily by reducing or replacing cement in concrete mixes through strategies like high performance aggregate selection or cement substitution. Carbon interventions can be made without a cost impact on the individual project if the criteria are effectively communicated to ready-mixed suppliers. Low-embodied carbon concrete does not need to require onerous changes to upstream industrial processes. However, it can be complex, depending on the mix, the location, and other site-specific details.

To comply with the code, some product manufacturers and/or suppliers will see a small financial impact from developing EPDs for their products. However, costs associated with low-carbon cement replacement and EPD development rarely show a financial cost to induvial projects because the investment is spread across multiple large projects. For example, a study by Energy Transitions Commission showed that the company pass-through cost to the individual projects to create the initial $5-30K EPD is negligible in 50,000 SF projects.

With grants from the Federal government soon to be available to support manufacturers with producing EPDs, there will be a negligible cost impact. IRA funding will support the design and construction industry's knowledge of embodied carbon, manufacturers' ability to reduce carbon emissions and will create more EPDs. Most directly related to buildings, $250M is allocated for an EPD Assistance Program with funding available until September 30, 2031.

Delayed Implementation:

The proponents and stakeholders engaged in the proposal development process recommend that project teams are given an additional year to comply with the code if adopted. Design teams need to ensure that the specifications include the requirements before they go out to bid. Contractors need to understand the requirements and secure subcontracts with their suppliers. Since this code would apply to projects over 50,000 SF, these projects often include multi-year design development prior to the permit stage. Providing time for the team to set the requirements and work together will lead to a more successful outcome.

Ready-mix contractors often have multi-year contracts with their suppliers. Therefore, to be competitive, they will want to understand the requirements, work with their suppliers or find new intermediaries to work on the larger building projects. Because the code only applies to larger projects, the requirement will not impact all concrete providers or even all buildings.