First Movers Coalition

WORLD ECONOMIC FORUM

First Movers Coalition Cement & Concrete Procurement Guide

WHITE PAPER

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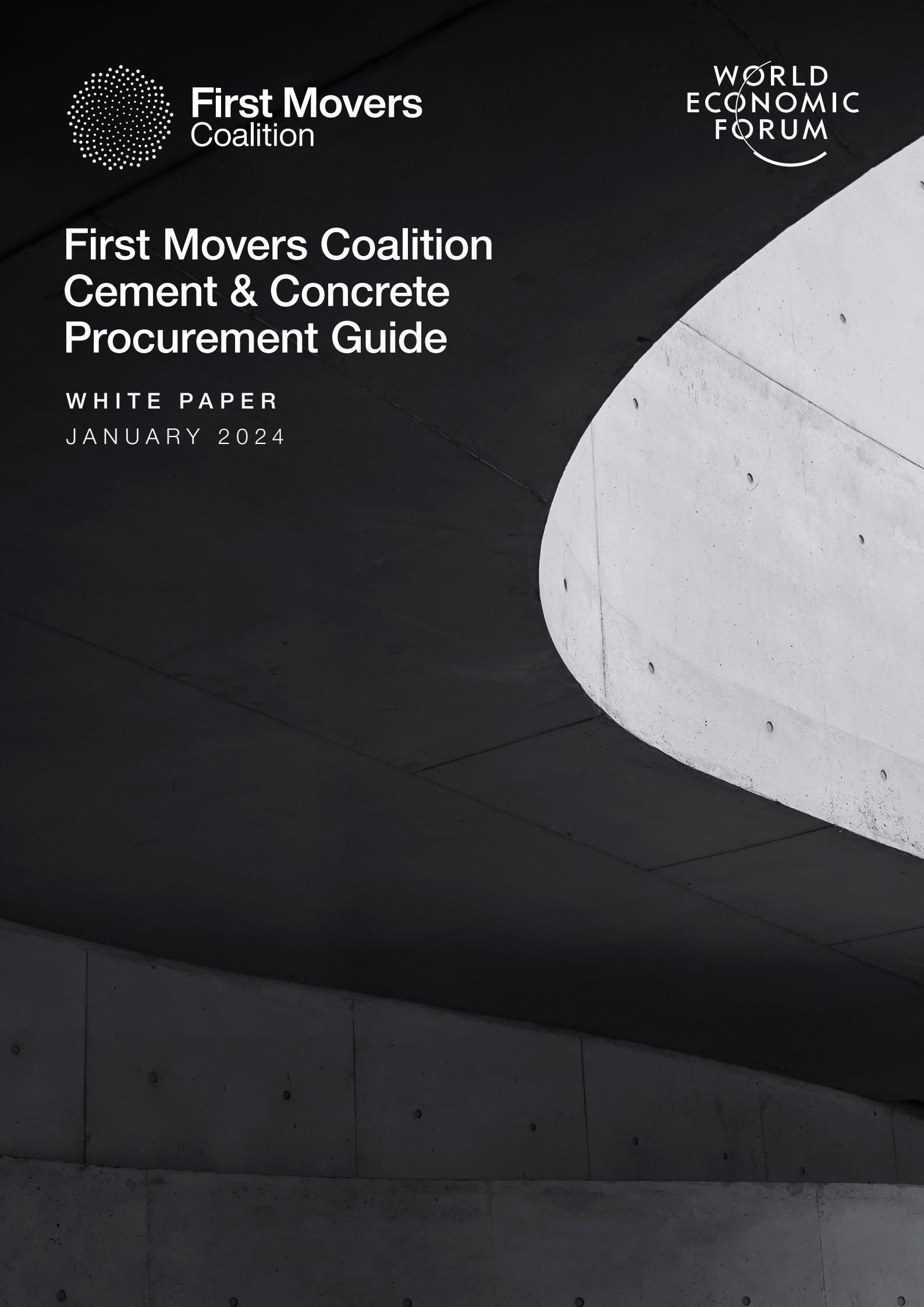

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Introduction

Cement and concrete manufacturing accounts for 7%-8% of annual global CO_2 emissions and the use of these materials will only rise as development continues across the world. Thus, the decarbonization of cement and concrete is critical to a net-zero future. However, there are several challenges to cement and concrete decarbonization.

According to a United States Department of Energy report, *Pathways to Commercial Liftoff: Low-Carbon Cement*, about 96% of all cement shipped goes through intermediaries (e.g., ready-mix concrete companies, concrete product manufacturers, contractors, and materials dealers). This means that clear communication that can pass through the supply chain is critical, a fact only compounded by a complex and evolving measurement and standards ecosystem.

Furthermore, although cement plants are generally upgraded and could be retrofitted every five to 10 years, full-scale investment in new plants is much rarer given the long life of capital assets. In fact, there is only one full investment cycle in new greenfield cement production facilities left before 2050. If cement and concrete producers are going to include decarbonization plans in the design of these new facilities, they must feel confident in rising demand for decarbonized cement and concrete.

Currently, long-term offtake agreements for cement and concrete are less common than short-term purchases. However, as decarbonization comes to the forefront and long-term offtake becomes more common, clearly specifying emissions targets to assist procurement activities will be key.

The First Movers Coalition (FMC) Cement & Concrete Procurement Guide is meant for individuals directly or indirectly procuring low-carbon cement and concrete. The intent is not to completely solve questions of standards and measurement but rather to provide a current lay of the land for low-carbon cement and concrete procurement, as well as language that may prove useful in passing along to suppliers and intermediaries.

Target audience

This document is aimed for use by those who are directly or indirectly (i.e., procuring cement and concrete products) procuring low-carbon cement and concrete. The document can be used by readers as a source of:

- Language that can be inserted into contracts to ensure that near-zero carbon cement and concrete purchased is in line with FMC thresholds
- Information on wider considerations relevant to the procurement of low-carbon cement and concrete

Scope and structure of the document

The guide contains three chapters.

Chapter 1. An overview of the FMC Cement & Concrete commitment and technology pathways that can be used to decarbonize cement and concrete production. Please note that these pathways are analysed in relation to the highly ambitious FMC definition of near-zero cement. Other initiatives and organizations may have different thresholds or definitions of near-zero or may be pursuing more generalized cement decarbonization.

Chapter 2. Procurement guidance and language that can be used in contracts, covering:

- Greenhouse gas emissions accounting produced within Environment Product Declarations using relevant product category rules
- Ongoing accounting issues such as:
  - Alternate fuels
  - Recarbonation
  - Carbon capture, utilization and storage
  - Carbon-accounting mechanisms such as mass balance and book-and-claim
  - CO_2 mineralization during curing and insets

Chapter 3. Links to further relevant documents for procurement teams involved with cement and concrete to consider. Guidance on the foundations that need to be in place for a procurement department to collaborate with partners and prepare for decarbonization can be found in this wider reading, including this Egon Zehnder report.

Note: There are significant gaps in the current cement and concrete standards environment that must be addressed to improve the comparability of near-zero emissions products. Organizations such as the Clean Energy Ministerial's Industrial Deep Decarbonization Initiative (IDDI) and Building Transparency are actively engaged in improving the harmonization of product category rules (PCRs) in cement, concrete and steel. Their work will also offer some commentary on cross-sectoral issues such as emissions allocation for steel slag used in cement production. This document is intended to provide an accurate view of the current landscape. However, as best practices for Environmental Product Declarations (EPDs) and PCRs develop, and as long-term offtake agreements become more commonplace, this document will eventually no longer be necessary.

In Chapter 3, a link is provided to the IDDI Secretariat's work, which will continue addressing the standards ecosystem over time.

Development process

The development of this document began following FMC Cement & Concrete working groups and bilateral engagements. In these calls, FMC Cement & Concrete members indicated that a guide to assist procurement activities, focusing on specifications and language that can be inserted into contracts by those procuring cement and concrete directly and indirectly, would be a useful deliverable.

It was developed by the World Economic Forum and Boston Consulting Group, with feedback incorporated from FMC Cement & Concrete members, select cement and concrete suppliers, IDDI, the Global Cement & Concrete Association (GCCA), and GCCA India.

Chapter 1

FMC commitment

Commitment overview

FMC members in cement and concrete commit to procuring 10% of their cement or their concrete purchased as near-zero. FMC's definition of near-zero is as follows:

1. Cement with embodied carbon below 184kg CO_2e/tonne of cement[1]

2. Concrete that is below a set of embodied carbon limits based on specified compressive strength

Embodied carbon should be calculated using a "cradle-to-gate" systems boundary, which includes typical EPD modules A1 (raw material supply), A2 (transport) and A3 (manufacturing). This boundary is consistent with implementation partner guidance, as well as both product-specific and industry-average EPDs. In cases where buyers purchase products that contain concrete but also include other materials or emissions sources, it is important to ensure that a GWP value that solely focuses on concrete emissions is also provided. This will help ensure FMC alignment can be assessed.

To meet the FMC threshold, these embodied carbon values should not include the impact of fossil-based supplementary cementitious materials (SCMs) after 2035, as the supply of these technologies relies on high-carbon industrial processes the FMC is aiming to displace.

For further details on the FMC cement and concrete commitment, including information on breakthrough technologies and SCMs, please see the overview here.

Specified compressive strength[2] (f'c in psi)	Embodied carbon (kg CO_2e/m^3)
0 - 2500 psi	70
2501 - 3000 psi	78
3001 - 4000 psi	96
4001 - 5000 psi	117
5001 - 6000 psi	124
6001 - 8000 psi	144

Technology pathways

There is a variety of technology pathways that may be useful for meeting the FMC thresholds. Procurement teams aiming to purchase low-carbon cement and concrete should consider these technologies' application in the cement and concrete they procure. It is likely that individual levers will not be sufficient and a combination of several technologies will be needed to achieve near-zero emissions.

Please note the technologies provided below are not exhaustive. The FMC is a technology-agnostic initiative and methods to reach the thresholds need not be limited to these technologies. New, relevant breakthrough technologies may emerge that can be considered for use in future efforts to align with FMC thresholds.

1. **Currently deployed measures:** These measures are technologically proven, compliant with existing building codes and, for the most part, are currently financially viable. According to the US Department of Energy Liftoff report, these measures could collectively reduce cement emissions 30% by the early 2030s.

– **Energy efficiency improvements:** Measures such as process control, more efficient internal transport systems, high-efficiency coolers and grinders, and high-efficiency motors and fans can slightly reduce cement emissions at minimal cost.

– **Renewables:** Increased use of renewable energy can decarbonize cement production.

– **Fuel switching:** Use of biomass or other low-emissions fuels can abate emissions from heating in cement production.

- **Use of supplementary cementitious materials:** SCMs are added to cement mixes to reduce the amount of clinker needed, offsetting emissions and cost. SCMs encompass both:
  - *Fossil-derived SCMs* such as ground-granulated, blast-furnace slag (GGBS) or fly ash which are more common today. These SCMs are out of scope for FMC beyond 2035 since they rely on fossil-based technologies that FMC aims to displace by focusing on deep decarbonization solutions.
  - *Non-fossil-based SCMs*, which are more nascent and include materials such as natural pozzolans or calcined clay heated with non-fossil sources.

2. **Carbon capture, utilization and storage (CCUS):** Carbon capture is seen as a critical technology to address the process emissions associated with clinker production for cement. Indeed, CCUS is the largest single factor in the GCCA's roadmap to net zero, accounting for 36% of all emissions reductions. Innovations such as oxyfuel combustion (replacing air with pure oxygen in fuel combustion) can facilitate increased CCUS rates. However, please note the oxyfuel combustion is likely cost-prohibited for retrofits and will be more applicable for new-build facilities.
3. **Alternative production methods for traditional cements:** These methods are focused on production processes using alternative feedstocks, electrochemical production systems, or electric kilns that may emerge as alternatives to traditional rotary kilns.
4. **Alternative cement chemistries:** Alternative cement chemistries such as calcium silicate that use non-clinker binders can significantly reduce emissions, but these are still quite nascent.
5. **Other methods:** Other innovations may also be used to further curb emissions. These may include:

- **Decarbonated raw materials:** Decarbonated materials, such as the fine material from recycled concrete, do not emit CO_2 when heated because they have already had the CO_2 removed. These can replace a portion of limestone in cement production. Other options for circular materials may emerge over time.
- **CO_2 mineralization during curing:** Injection of captured CO_2 from other industries during concrete curing. Not only does this provide an end use for carbon captured elsewhere but it can also further reduce emissions by improving compressive strength and facilitating mix optimization.

Chapter 2

Procurement guidance

Context

Within cement and concrete, the best practice for measuring embodied emissions is calculating a global warming potential (GWP) value within an Environmental Product Declaration (EPD) that is produced in accordance with associated product category rules (PCRs), or within a third-party, audited/validated, carbon footprint study based on the same PCRs. The IDDI Secretariat has endorsed the declaration of environmental impact through EPDs, based on common PCRs.[3]

It is worth noting that these standards are not globally uniform. PCRs vary regionally and may have differences in the exact methodologies recommended for emissions calculation when producing EPDs. Generally, FMC will accept GWP values contained within EPDs produced in accordance with these standards, which are considered most internationally relevant for cement and concrete:

- **ISO 21930:2017** and relevant sub-PCRs. This is an international standard that is most used in North America, although it also has some other global use.
- **EN-15804:2012+A2:2019** and relevant sub-PCRs. This is a European standard most commonly seen in the European Union, but also used in countries such as Brazil and India.

Please note that when these standards are referenced in this guide, the versions according to the dates above are being referenced.

Even using the same PCR, values calculated for the same product may vary depending on several factors, including how much primary data is gathered and which secondary dataset is used. The IDDI Secretariat, as well as other organizations, are trying to drive the industry towards higher use of primary data and towards more standardized data practices in general. The full process of harmonizing PCRs to ensure comparability and consensus on issues such as GWP will likely take years. More can be read on this topic in the resources linked in Chapter 3.

It is also worth noting that neither ISO 21930 nor EN-15804+A2 give guidance on how to factor in CCUS. Thus, we have provided instructions for CCUS incorporation in the suggested procurement language following this sub-section. However, our guidance may become out of date over time as regulatory clarity establishing CCUS use as part of cement and concrete emissions reporting is expected in the EU in one to two years. Additionally, several other organizations are working on ecosystem alignment for this topic, including the Clean Energy Ministerial CCUS initiative and IDDI; ISO (topic committee 265); and the CCS+ Initiative. FMC will aim to coordinate with partners in keeping procurement guidance up-to-date as appropriate, and contracts should be designed with some flexibility to adapt to changing standards.

Finally, in addition to relevant standards, this guide also aims to identify ongoing issues that need to be addressed and provide guidance where possible. These issues include the use of alternate fuels, recarbonation, CCU, alternative chain of custody accounting mechanisms and curing/insets.

Standards referenced below

Standard	Topics covered
ISO 21930:2017	Defines the principles, specifications and requirements to develop an EPD for construction products
EN-15804:2012+A2:2019	Details rules for European EPDs within the product category of construction products
ISO 14067:2018	Covers the principles, requirements and guidelines for quantifying and reporting the carbon footprint of a product
ISO/TR 27915:2017	Topic review on “best practices” for quantifying and verifying GHG emissions and reductions from CCS at the project level
ISO/ TR 27922	Topic review on CCUS technologies used in the cement industry

Guidance

Emissions calculation
A cement or concrete product meets the FMC threshold if its embodied emissions are calculated as below the threshold within an Environmental Product Declaration (EPD) created in accordance with **ISO 21930** or with **EN-15804+A22**.

Carbon capture and storage
Given that PCRs within these standards do not currently account for CCS, in the case it is deployed at the cement production stage, the supplier should report CCS abatement supplementally, calculated in alignment with **ISO 14067**. For purposes of meeting the FMC threshold, suppliers should subtract this CCS abatement value from the cement or concrete EPD's GWP value. This means that CCS impact may be layered on top of decarbonization from levers such as biofuel use. However, it is also critical to be aware of any considerations from domestic legislation that affect CCS use.[4]

For additional background, FMC recommends consulting ISO topic reviews on CCUS such as **ISO/ TR 27922**, which summarizes technologies for capturing CO_2 generated by cement manufacture. Additionally, **ISO/TR 27915** may be useful, which reviews materially relevant issues and options relating to "good practices" for quantifying and verifying CCS. **ISO/27914:2017** also may be used to guide onshore and offshore geological storage of CO_2.

Finally, local regulations such as the US Subpart RR or EU CCS Directive may also be relevant for ensuring CCUS used can count towards compliance and incentive schemes.

Other ongoing issues

Alternate fuels
The emissions impact of biogenic fuels and non-biogenic waste-based fuels is a topic of discussion in the cement and concrete space. Our guidance is as follows:

Biogenic carbon: The use of biogenic carbon such as biomass or biofuels can reduce emissions vs fossil-fuel sources so long as those biogenic sources are sourced sustainably. In many standards as well as construction PCRs, these fuels are "carbon-neutral" and have a GWP of zero. See GHGP guidance on this topic for a more detailed review. The rules concerning deploying biomass and biofuels alongside CCUS may vary depending on emissions trading systems (ETS) or other local regulations. Often, biomass use must be registered or certified under a standard, regulation or programme that promotes the use of renewable biomass and bioenergy, including the US Environmental Protection Agency's (EPA), Renewable Fuel Standard, the EU's REDII Directive, or Canada's Clean Fuel regulation.

Waste: Some companies account for avoided emissions in the waste sector gained from combusting waste. For example, the burning of food waste may prevent methane emissions that would occur from that food waste decomposing in a landfill. However, the IDDI Secretariat's perspective is that these avoided emissions should not be counted in the product carbon footprint (PCF) since they occur outside the A1, A2, A3 "cradle-to-gate" system boundary.

Non-biogenic waste: There is an additional consideration for the combustion of non-biogenic waste. Some companies argue that they should not be allocated the emissions from waste combustion due to the perceived benefits of using societal waste as a fuel rather than disposing of it in landfill or incinerating it. They thus subtract these emissions from a "net" emissions figure. In line with IDDI guidance, emissions from combustion of non-biogenic waste fuels should be considered in a product's gross emissions value. Both the gross and the net figure should be reported in an EPD for completeness.

Carbon capture and utilization
Carbon capture and utilization (CCU) is more complicated to account for than CCS, since different CCU outcomes have different levels of permanence in terms of sequestering carbon. Emissions trading systems (ETS) have some variance in terms of how they address CCU, which can be deployed during cement production:

- *ETS regulations that allow emissions reductions claims only for more permanent outcomes:*
  - **In the EU ETS**, companies that are mineralizing CO_2 from industrial point sources into products can reduce compliance obligations. However, other CCU outcomes are not permitted for abatement.
    - However, industrial CCU can be used as a source for "renewable fuels" until 2041, meaning downstream users may benefit.
  - **In Brazil's proposed ETS legislation**, release into the atmosphere of "previously removed or captured greenhouse gases" must be avoided.
- *ETS regulations that allow emissions reductions claims for all CCU outcomes:*
  - **New Zealand's ETS and Quebec's cap-and-trade system** both contain mechanisms for regulated entities to reduce their obligations through CCU, regardless of the permanence of the outcome.

- *ETS regulations where CCU is still unclear:*
  - **California's cap-and-trade** has ongoing discussions about amendments that would allow reductions of compliance obligations via CCUS, but no current mechanisms allow producers to do so.
    - Across the US, however, CCU projects may apply for 45Q tax credits by submitting an LCA in accordance with Clean Air Act guidance.
  - **Other systems** have no explicit regulations touching on CCUS at all.

Please note that CCUS is a rapidly evolving policy area, and this information is correct as of December 2023. FMC will aim to coordinate with IDDI in keeping its members up to date as a view on best practice evolves, given IDDI is planning on further consultation related to CCU in 2024.

Recarbonation

Recarbonation describes the process through which concrete removes carbon from the atmosphere via the slow absorption of CO_2. This is an ongoing issue in concrete carbon accounting since recarbonation impacts are highly dependent on the specific application and surface area of the final concrete product. Given this uncertainty as well as the FMC's "cradle-to-gate" system boundary, most recarbonation effects are not in scope for FMC thresholds. The exception is recarbonation that occurs within this "cradle-to-gate" boundary for pre-cast products such as cinderblocks,[5] which may be counted per EN 15804 guidance.

Alternative chain of custody accounting mechanisms

The use of mass balance and book-and-claim in cement and concrete lacks global clarity. Given book-and-claim is unlikely to succeed without a global registry, FMC recommends against its use in cement. For the use of mass balance, FMC encourages assurance in line with emerging guidance from the Greenhouse Gas Protocol and the IDDI Secretariat. Further guidance may also become available from ISO topic committees 207 and 308, or from regional regulations.

Curing or other insets

The injection of captured carbon in concrete mixes may confer emissions reductions by facilitating mix optimization or allowing for improved compressive strength without using more cement. However, FMC would discourage members from "claiming" the emissions sink associated with providing an end use for captured carbon for two reasons. First, the company that captured the point source carbon may seek to claim that sink: double counting should be avoided. Second, FMC wants to pull forward technologies that decarbonize cement and concrete, not necessarily to promote general decarbonization in other sectors. Thus, achieving the FMC threshold through reductions mainly carried out in a different sector might be problematic. Instead, FMC would recommend the company note the carbon sink as a supplemental item in reporting.

In terms of "insets", some companies may sell emissions credits linked to reductions elsewhere in their supply chain. They may tag these credits to cement or concrete. FMC discourages these sorts of processes insofar as the emissions reduction occurs outside the A1, A2, A3 system boundary. This is to keep the focus on pulling forward breakthrough cement and concrete decarbonization technologies.

Chapter 3

Additional links

As cement and concrete production guidance and regulation is constantly changing, the following links provide additional resources to understand more about the topic. In particular, we recommend reading the IDDI Secretariat's Product Category Rules harmonization work, which seeks to coordinate standards in cement, concrete and steel. This will affect CCUS guidance, which is particularly relevant to cement and concrete procurement.

External resources

Industrial Deep Decarbonization Initiative (IDDI)

- IDDI is a global coalition of public and private organizations working to stimulate demand for low-carbon industrial materials, working primarily with national governments and focusing on public procurement.
- The IDDI Secretariat's work on harmonizing standards across cement, concrete and steel can be found in their Driving Consistency in the Greenhouse Gas Accounting System report.

Mission Possible Partnership Report - Making Net-Zero Concrete and Cement Possible: An Industry Acknowledged, 1.5°C-Aligned Transition Strategy

- A "real-world" strategy created with industry input that sets out milestones and commitments needed by government, industry and investors over the next 25 years to make net-zero emissions concrete and cement a reality.
- It uses granular economic modelling with two pathways to net-zero emissions by 2050.
- One of a series of MPP net-zero transition strategy reports across the hard-to-abate industrial sectors.

Mission Possible Partnership Report – Low-Carbon Concrete and Construction: A review of Green Public Procurement Programmes

- A report collating low-carbon procurement efforts in progress to provide constructive ideas for policy-makers, building regulators and procurement offices as they create their own frameworks, tools and policies to meet climate change requirements.

LeadIt Green Cement Technology Tracker

- A tool presenting public announcements of investments in low-carbon cement technologies.
- It currently includes carbon capture technologies.

US Department of Energy: Pathways to Commercial Liftoff – Low Carbon Cement

- One of a series of reports aiming to establish a common fact base and ongoing dialogue with the private sector on the path to commercial lift-off for critical clean energy technologies across core US industries.

GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete

- A roadmap explaining how collaboration between built environment stakeholders and policy-makers can fully decarbonize the cement and concrete industry.

IEA Achieving Net Zero Heavy Industry Sectors in G7 Members Report

A report focusing on two key areas for achieving net-zero heavy industry sectors in G7 members: a toolbox of policies and financing mechanisms to initiate and sustain the industry sector transition; a series of common and practicable definitions of what constitutes near-zero emission steel and cement production.

- Please note this report uses a different definition of near-zero cement than FMC. Their emissions threshold should not be used in lieu of the FMC threshold, but the information on systems boundaries is still relevant.

GCCA Blended Cement: Green, Durable and Sustainable report

- GCCA report from 2022 on the benefits of blended cement.
- It highlights the quality benefits and CO_2 footprint of blended cement in India.

GCCA Getting the Numbers Right database

- Database on emissions and other key indicators associated with phases of cement and concrete production.

Egon Zehnder: The Power of Procurement: Tackling the Climate Challenge

– Report outlining how procurement is a critical lever for putting business on a sustainable path; the transformations needed in and around companies' procurement function; and what a new approach to procurement means for chief procurement officers' leadership mindsets and capabilities.

Building Transparency Embodied Carbon in Construction Calculator (EC3) Database

– A free database of construction EPDs and matching building impact calculator for use in design and material procurement.

World Economic Forum cement & concrete articles

Cementing your lead: The cement industry in the net-zero transition

– Article outlining new decarbonizing technologies in the cement and concrete sector and the business models that may be required to deploy them at scale.

Low carbon design can reduce cement emissions by 40% - here's how to deploy it at scale

– Article explaining how low-carbon design and construction can reduce emissions, the barriers to its adoption and how it could be scaled further.

How to decarbonize concrete and build a better future

– Article on ways to decarbonize concrete: reducing clinker's carbon footprint, cleaner codes, cooperation across the value chain and between public and private actors.

How circularity can increase profits in cement and concrete

– Article explaining how the concrete and cement industries can embrace the circular economy as an opportunity to unlock value.

World Economic Forum white paper

Scaling Low-Carbon Design and Construction with Concrete: Enabling the Path to Net-Zero for Buildings and Infrastructure

– A seven-part framework for scaling low-carbon design to reduce cement and concrete emissions.

Endnotes

1. The embodied carbon for portland cement is closer to 900 kg CO_2e/tonne.
2. Table can be converted to megapascals (MPa) by dividing pounds per square inch (psi) by 145.04.
3. Projects that have not yet come online may lack the operational data needed to produce an EPD. In other sectors, such as steel, there are emerging pre-assessment methodologies that allow for emissions assessment without operating data. However, these methods do not yet exist in cement and concrete.
4. CCS use may additionally be impacted by local ETS regulations. For instance, in the EU the storage cannot occur outside EU jurisdiction if the CCS is to be counted to reduce compliance obligations.
5. It is worth noting that standardized datasets providing emissions estimates for pre-cast recarbonation effects are not widely available. Thus, estimating pre-cast recarbonation effects may be more difficult than determining emissions for raw material preparation, clinker production, etc.

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