CLIMATE ACTION RESERVE

Low-Carbon Cement v1.0

Workgroup Meeting #4
March 17, 2023

Housekeeping

- Workgroup members have the opportunity to actively participate throughout the meeting
  - Ask that you keep yourselves muted unless / until would like to speak
- We will ask and take questions throughout the session
  - Please use the raise your hand function
- All other attendees/observers are in listen-only mode
- Observers are free to submit questions in the question box
- We will follow up via email to answer any questions not addressed during the meeting
- The slides and a recording of the presentation will be posted online
- Break around the 2 hour mark

Workgroup Members

David Bangma	Ash Grove
Jamie Meil	Athena Institute
James Salazar	Athena Institute (Alternate)
Seth Baruch	Carbonomics
Ram Verma	CDWR
Lauren Mechak	ClimeCo
Kayla Carey	ClimeCo (Alternate)
Danny Gray	Eco Materials
Gaurav Sant	Institute for Carbon management UCLA
David Perkins	Lehigh Hanson
Adam Swercheck	Lehigh Hanson
Matthew Lemay	National Ready Mix Concrete Association
Thomas Van Dam	Nichols Consulting Engineers (NCE)
Christina Theodoridi	NRDC
Lauren Kubiak	NRDC (Alternate)
Jamie Farny	Portland Cement Association
Eric Giannini	Portland Cement Association (Alternate)
Miguel Angel Freyermuth	Ruby Canyon Environmental
James Carusone	Salt River Materials Group
Jimmy Knowles	SEFA Group

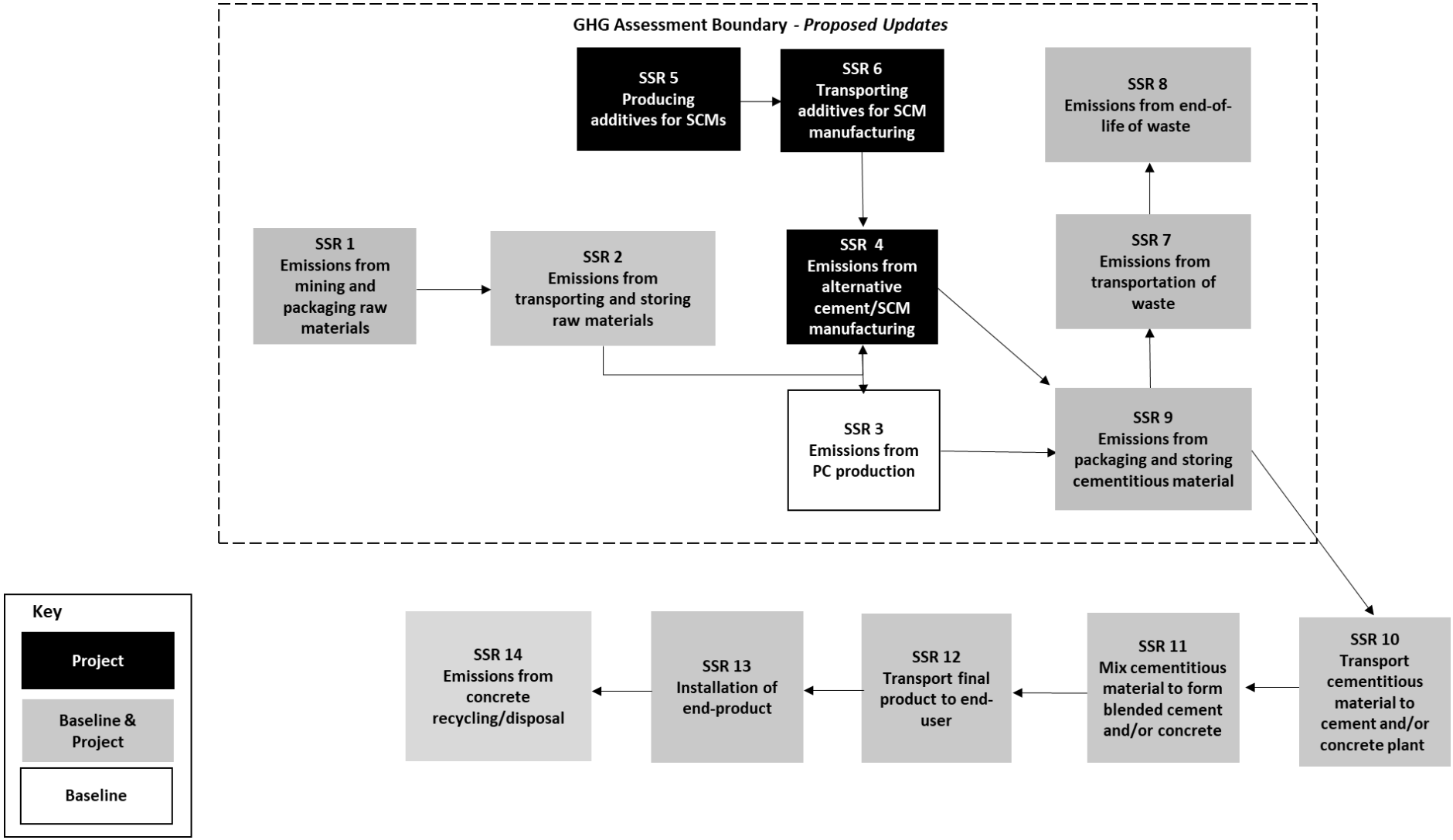
AGENDA

- Protocol considerations
  - **GHG assessment boundary**
  - **Quantification**
  - **Monitoring / Reporting / Verification**
  - **Follow-up**
    - Ownership
    - ASTM Standards
    - Performance Standard Test
    - Leakage
- Next steps

CLIMATE ACTION RESERVE

GHG ASSESSMENT BOUNDARY

The GHG Assessment Boundary



The GHG Assessment Boundary - Baseline

SSR	Description	Included Gas(es)	Quantification Method*
1	Emissions from mining raw materials	CO_2	Default factors – mining
2	Emissions from transportation and storage of raw materials	CO_2	Emission factors
3	Emissions from OPC production	CO_2, CH_4, N_2O, etc	Emissions based on electricity, fuel consumption & calcination
4	Emissions from packaging and storing cement	CO_2	Emissions based on electricity & fuel consumption
5	Emissions from transportation of waste	CO_2	Emission factors

*proposed

3, or majority of baseline, likely not included in jurisdictions under cap-and-trade

- Are any SSRs missing from this table that should be included?
- Are any SSRs included in this table that should *not* be included?

The GHG Assessment Boundary - Project

SSR	Description	Included Gas(es)	Quantification Method*
1	Emissions from mining of raw materials	CO_2	Default factors – mining
2	Emissions from transportation and storage of raw materials	CO_2	Emission factors
3	Emissions from production of additives	CO_2, CH_4, N_2O, etc	Emissions based on electricity & fuel consumption
4	Emissions from transportation of additives	CO_2	Emission factors
5	Emissions from SCM manufacturing	CO_2, CH_4, N_2O, etc	Emissions based on electricity & fuel consumption
6	Emissions from packaging and storing cement	CO_2	Emissions based on electricity & fuel consumption
7	Emissions from transportation of waste	CO_2	Emission factors
8	Others from end use?	CO_2, CH_4, N_2O, etc	Default factors

*proposed

- Are there any SSRs that are missing or that should *not* be included?

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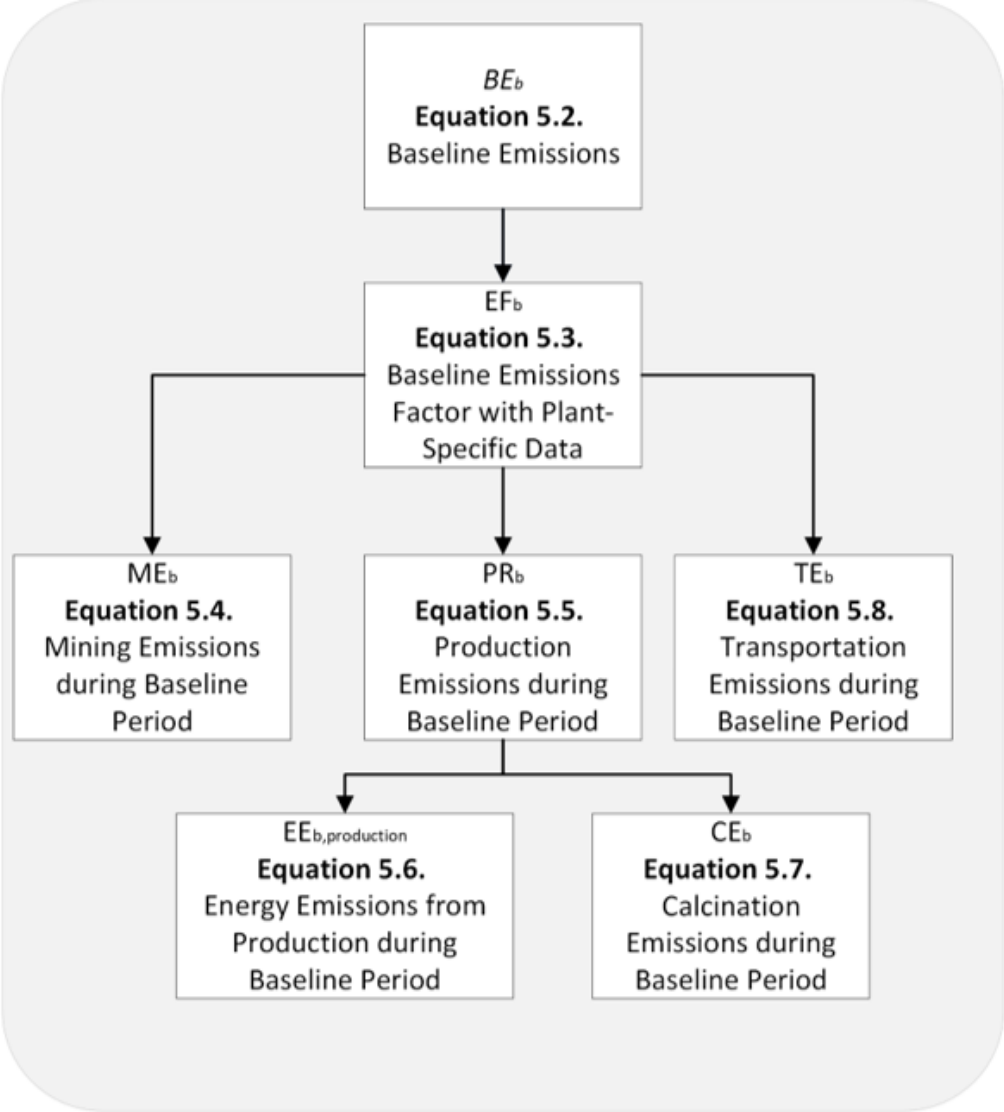
QUANTIFICATION

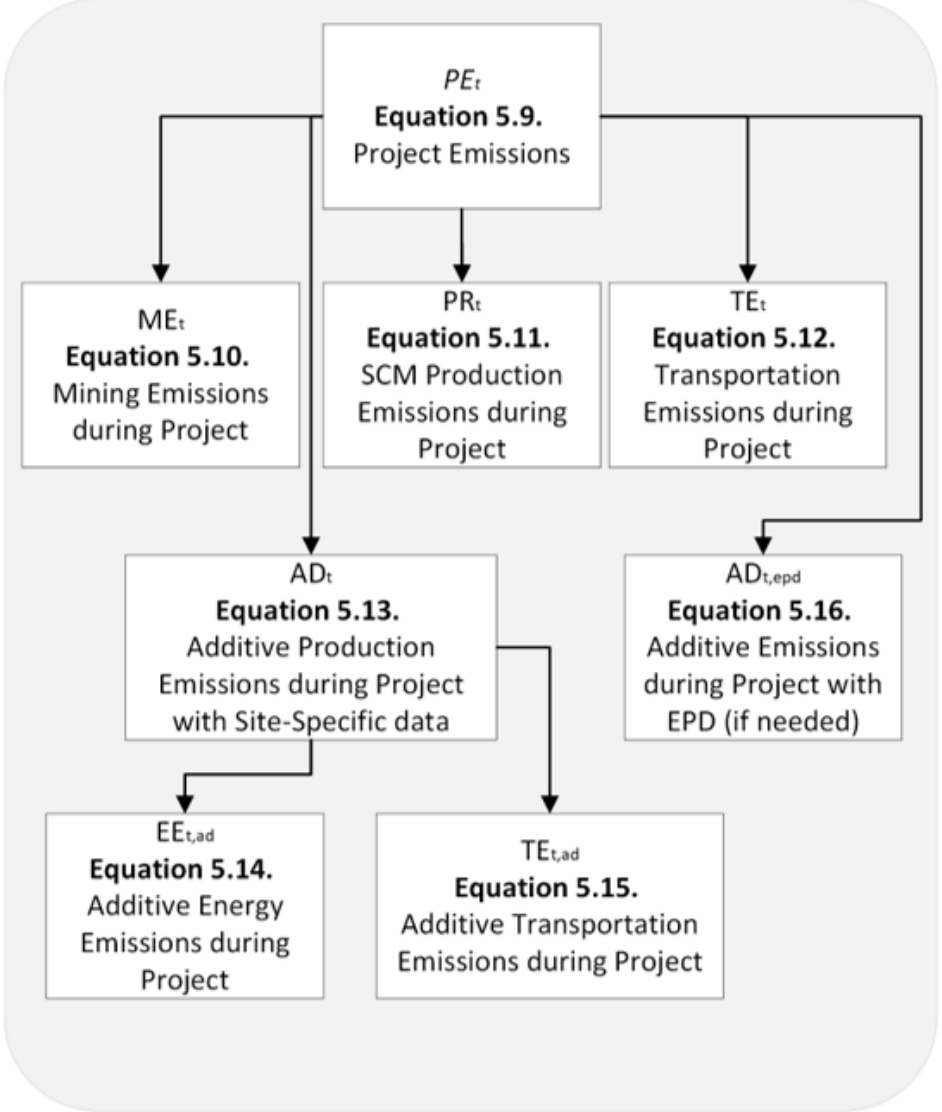
Quantification – Emission Reduction

$$ER = BE - PE$$

Where,			Units
ER	=	Total emission reductions for reporting period.	tCO_2e
BE	=	Total baseline emissions from all SSRs in the GHG Assessment Boundary, see Equation 5.2.	tCO_2e
PE	=	Total project emissions from all SSRs in the GHG Assessment Boundary, see Equation 5.9.	tCO_2e

Quantification – Emission Reduction





CLIMATE ACTION RESERVE

QUANTIFICATION – BASELINE EMISSIONS

Quantification – Baseline Emissions

- Total emissions for production of OPC
  - Mining emissions for OPC production
  - OPC production emissions including calcination
  - Transportation emissions for OPC production
- Additional captured and mineralized CO_2

$$BE = (Q_b \times R_b \times EF_b) + CO_2$$

Where,			Units
BE	=	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary.	tCO_2e
Q_b	=	Total quantity of PC that would have been produced during the reporting period.	tonnes
R_b	=	PC to SCM weight adjustment factor in period during the reporting period.	percent
EF_b	=	CO_2 emission factor for PC production during the reporting period.	tCO_2e/tonne of PC
CO_{2CAP}	=	Quantity of CO_2 captured and permanently removed through mineralization into cement or cement additives	tonnes

Quantification – Baseline Emission Factor

The determination of the emission factor for OPC production is carried out using one of the following three **hierarchical** approaches:

1. Historical OPC production records using plant-specific data

$$EF_b = \frac{(ME_b + PR_b + TE_b)}{Q}$$

Where,			Units
EF_b	=	CO_2 emission factor for PC production during the look-back period.	tCO_2e/tonne of PC
ME_b	=	Mining emissions for PC production during the look-back period.	tCO_2e
PR_b	=	Production emissions for PC production during the look-back period.	tCO_2e
TE_b	=	Transport emissions for PC production during the look-back period.	tCO_2e
Q	=	Quantity of PC produced during the look-back period.	tonnes

2. **Estimated emission factor using Environmental Product Declarations (EPDs)**
3. Published emission factor using regional data

Quantification – Baseline Emissions

Quantity of CO_2 captured and permanently removed through mineralization into cement or cement additives

$$CO_{2CAP} = \left(Q_{cement} \times \left(C_{sample,p} - C_{sample,b}\right)\right) \times \frac{44}{12}$$

Where,

			Units
CO_{2CAP}	=	Quantity of CO_2 captured and permanently removed through mineralization into cement or cement additives.	tCO_2e
Q_{cement}	=	Quantity of material subjected to mineralization.	tonnes
$C_{sample,p}$	=	Carbon within project sample after analysis.	grams
$C_{sample,b}$	=	Carbon within baseline sample after analysis.	grams

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BASELINE EMISSIONS - PLANT SPECIFIC DATA APPROACH #1

Quantification – Baseline Mining Emissions

- Plant Specific Data Approach

$$ME_b = (EL_{b,mining,grid} \times EF_{b,mining,grid}) + (FC_{b,mining} \times EF_{b,mining,fuel})$$

Where,			Units
ME_b	=	Mining emissions for PC production during the look-back period.	tCO_2e
$EL_{b,mining,grid}$	=	Grid electricity consumption for PC mining during the look-back period.	kWh
$EF_{b,mining,grid}$	=	CO_2 emission factor for grid electricity consumed during the look-back period from the most recent U.S. Environmental Protection Agency (EPA) eGRID emission factor publication.[20] Projects shall use the annual total output emission rates for the subregion where the project is located.	tCO_2/kWh
$FC_{b,mining}$	=	Fuel consumption for PC mining during the look-back period.	tonnes of fuel
$EF_{b,mining,fuel}$	=	CO_2 emission factor for fuel consumed during the look-back period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[21] Projects shall use the CO_2 factor for the appropriate fuel type.	tCO_2e/ tonne of fuel

Quantification – Baseline Production Emissions

- Plant Specific Data Approach

$$PR_b = EE_b + CE_b$$

Where,			Units
PR_b	=	Production emissions for PC production during the look-back period.	tCO_2e
EE_b	=	Energy emissions for PC production during the look-back period.	tCO_2e
CE_b	=	Calcination emissions for PC production during the look-back period.	tCO_2e

Quantification – Baseline Energy Emissions

- Plant Specific Data Approach

$$EE_b = (EL_{b,production,grid} \times EF_{b,production,grid}) + (FC_{b,production} \times EF_{b,production,fuel})$$

Where,			Units
EE_b	=	Energy emissions for PC production during the look-back period.	tCO_2e
$EL_{b,production,grid}$	=	Grid electricity consumption for PC production during the look-back period.	kWh
$EF_{b,production,grid}$	=	CO_2 emission factor for grid electricity consumed during the look-back period from the most recent EPA eGRID emission factor publication.[22] Projects shall use the annual total output emission rates for the subregion where the project is located.	tCO_2/kWh
$FC_{b,production}$	=	Fuel consumption for PC production during the look-back period.	tonnes of fuel
$EF_{b,production,fuel}$	=	CO_2 emission factor for fuel consumed during the look-back period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[23] Projects shall use the CO_2 factor for the appropriate fuel type.	tCO_2e/ tonne of fuel

Quantification – Baseline Calcination Emissions

- Plant Specific Data Approach

$$CE_b = R_{b,clinker} \times EF_{b,clinker}$$

Where,			Units
CE_b	=	Calcination emissions for PC production during the look-back period.	tCO_2e
$R_{b,clinker}$	=	Clinker to cement ratio for PC production during the look-back period.	Percent
$EF_{b,clinker}$	=	CO_2 emission factor for clinker during the reporting period from the most recent national emissions data.[24]	tCO_2e/ tonne of clinker

Quantification – Baseline Calcination Emissions

- Plant Specific Data Approach

$$TE_b = \sum d_b \times EF_{b,transport}$$

Where,			Units
TE_b	=	Transport emissions for PC production during the look-back period.	tCO_2e
d_b	=	Distance traveled for PC production during the look-back period.	miles
$EF_{b,transport}$	=	CO_2 emission factor for mode of transport during the look-back. Period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[25] Projects shall use the CO_2 factor for the appropriate transportation mode.	tCO_2e/ mile

CLIMATE ACTION RESERVE

QUANTIFICATION – PROJECT EMISSIONS

Quantification – Project Emissions

Total emissions for production of SCM manufacturing

- Mining emissions for SCM production
- SCM production emissions
- Transportation emissions for SCM production
- Transportation emissions for SCM production
- Mining emissions for production and transportation of additives
- End-of-life of waste emissions

$$PE_{\square} = \sum_{s} ME_{t,s} + PR_{t,s} + TE_{t,s} + WE_{t,s} + AD_{t,s}$$

Where,			Units
PE	=	Project emissions for SCM manufacturing during the reporting period.	tCO_2e
$ME_{t,s}$	=	Mining emissions for SCM manufacturing during the reporting period for all eligible SCMs "s".	tCO_2e
$PR_{t,s}$	=	Production emissions for SCM manufacturing during the reporting period for all eligible SCMs "s".	tCO_2e
$TE_{t,s}$	=	Transport emissions for SCM inputs to manufacturing, storage, additives, and waste during the reporting period for all eligible SCMs "s".	tCO_2e
$WE_{t,s}$		End-of-life of waste emissions generated during SCM manufacturing	tCO_2e
$AD_{t,s}$	=	Additive production emissions for SCM manufacturing during the reporting period.	tCO_2e

Quantification – Mining Emissions

- Mining emissions for SCM production
- SCM production emissions
- Transportation emissions for SCM production
- Transportation emissions for SCM production
- Mining emissions for production and transportation of additives
- End-of-life of waste emissions

$$ME_t = (EL_{t,mining,grid} \times EF_{t,mining,grid}) + (FC_{t,mining} \times EF_{t,mining,fuel})$$

Where,			Units
ME_t	=	Mining emissions for inputs to SCM manufacturing during the reporting period.	tCO_2e
$EL_{t,mining,grid}$	=	Grid electricity consumption for SCM mining during the reporting period.	kWh
$EF_{t,mining,grid}$	=	CO_2 emission factor for grid electricity consumed during mining in the reporting period from the most recent EPA eGRID emission factor publication.[29] Projects shall use the annual total output emission rates for the subregion where the project is located.	tCO_2/kWh
$FC_{t,mining}$	=	Fuel consumption for SCM mining during the reporting period.	tonnes of fuel
$EF_{t,mining,fuel}$	=	CO_2 emission factor for fuel consumed during the reporting period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[30] Projects shall use the CO_2 factor for the appropriate fuel type.	tCO_2/ tonne of fuel

Quantification – Mining Emissions

- Mining emissions for SCM production
- SCM production emissions
- Transportation emissions for SCM production
- Mining emissions for production and transportation of additives
- End-of-life of waste emissions

$$PR_{t,s} = (EL_{t,production,grid} \times EF_{t,production,grid}) + (FC_{t,production} \times EF_{t,production,fuel})$$

Where,			Units
$PR_{t,s}$	=	Production emissions for SCM manufacturing during the reporting period.	tCO_2e
$EL_{t,production,grid}$	=	Grid electricity consumption for SCM manufacturing or CO_2 capture/compression during the reporting period.	kWh
$EF_{t,production,grid}$	=	CO_2 emission factor for grid electricity consumed during the reporting period from the most recent EPA grid emission factor publication.[31] Projects shall use the annual total output emission rates for the subregion where the project is located.	tCO_2/kWh
$FC_{t,production}$	=	Fuel consumption for SCM production CO_2 capture/compression during the reporting period.	tonnes of fuel
$EF_{t,production,fuel}$	=	CO_2 emission factor for fuel consumed during the reporting period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[32] Projects shall use the CO_2 factor for the appropriate fuel type.	tCO_2/ tonne of fuel

Quantification – Transportation Emissions

- Mining emissions for SCM production
- SCM production emissions
- Transportation emissions for SCM production
- Mining emissions for production and transportation of additives
- End-of-life of waste emissions

$$TE_{t,s} = \sum_{s} d_{t,s} \times EF_{t,s,transport}$$

Where,			Units
$TE_{t,s}$	=	Transport emissions for SCM inputs to manufacturing, storage, additives, captured CO_2, and waste during the reporting period for all eligible SCMs "s".	tCO_2e
$d_{t,s}$	=	Distance traveled for SCM manufacturing during the reporting period.	miles
$EF_{t,s,transport}$	=	CO_2 emission factor for mode of transport during the reporting period from the most recent EPA Emission Factors for Greenhouse Gas Inventories.[33] Projects shall use the CO_2 factor for the appropriate transportation mode.	tCO_2/ mile

Quantification – End-of-Life Waste Emissions

- Mining emissions for SCM production
- SCM production emissions
- Transportation emissions for SCM production
- Mining emissions for production and transportation of additives
- End-of-life of waste emissions

$$WE_{t,s} = \sum_{s} qw_{t,s} \times EF_{t,s,waste}$$

Where,			Units
$WE_{t,s}$	=	End-of-life waste emissions generated during SCM manufacturing	tCO_2e
$qw_{t,s}$	=	Quantity of waste generated during SCM manufacturing.	t
$EF_{t,s,transport}$	=	CO_2 emission factor for end-of-life of waste from the most recent X. Projects shall use the CO_2 factor for the appropriate disposal method (landfill, incineration, recycling.	tCO_2/ t

Quantification – Additives

- For simplicity and usability, the project developer may exclude emissions for additives that make up 5% or less of the total SCM product by weight as these emissions are considered negligible.
- If total additives make up **5% or more** of the final SCM product by weight, the emissions associated with the primary additive(s) must be calculated. Secondary additives may be excluded from the calculation up to 5% of the total SCM product by weight.
- Hierarchy for data
  - Estimated emission factor using EPDs

$$AD_{t,s} = \sum_{s} Q_{t,ad} \times EF_{t,ad}$$

Where,			Units
$AD_{t,s}$	=	Emissions for additive production during the reporting period for all eligible SCMs.	tCO_2e
$Q_{t,ad}$	=	Quantity of additives used during the reporting period.	tonnes
$EF_{t,a}$	=	CO_2 emission factor for additive production during the reporting period.	tCO_2/tonne of additive

  - Published emission factor using regional data

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MONITORING, REPORTING AND VERIFICATION

Monitoring / Reporting / Verification (MRV)

Monitoring	Data Collection	Reporting Period	Verification
• Data collection frequency • Record keeping plan • QA/QC provisions • Legal requirement test	• Electricity and fuel consumption • Distance traveled • Quantity of SCM produced • Weight adjustment factor • OPC emission factor	• Flexible, based on SCM production, with maximum of 12 months	• Documentation and data review • Data management • Site visit • Sales receipts & sales volumes

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
Regulations	Project developer attestation of compliance with regulatory requirements relating to the project	N/A	Environmental regulations	Each verification cycle
ER	Total emission reductions for the reporting period	tCO_2e	c	Each reporting period
BE	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary	tCO_2e	c	Each reporting period
PE	Total project emissions for the reporting period, from all SSRs in the GHG Assessment Boundary	tCO_2e	c	Each reporting period
Q_b	Total quantity of PC that would have been produced during the reporting period	Tonnes	o	Monthly
R_b	SCM to PC weight adjustment factor in period during the reporting period	Percent	o	Each reporting period
CO_{2CAP}	Quantity of CO_2 captured and permanently removed through mineralization into cement or cement additives.	tCO_2e	c	Each reporting period
EF_b	CO_2 emission factor for PC production during the reporting period	tCO_2/tonne of PC	r,c	Each reporting period (if referenced) or once at validation (if calculated)

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
ME_b	Mining emissions for PC production during the look-back period	tCO_2e	c	Once at validation
PR_b	Production emissions for PC production during the look-back period	tCO_2e	c	Once at validation
TE_b	Transport emissions for PC production during the look-back period	tCO_2e	c	Once at validation
Q	Quantity of PC produced during the look-back period	tonnes	m	Once at validation
$EL_{b,mining,grid}$	Grid electricity consumption for PC mining during the look-back period	kWh	m	Monthly
$EF_{b,mining,grid}$	CO_2 emission factor for grid electricity consumed during the look-back period	tCO_2/kWh	r	Each reporting period
$FC_{b,mining}$	Fuel consumption for PC mining during the look-back period	tonnes of fuel	m	Monthly
$EF_{b,mining,fuel}$	CO_2 emission factor for fuel consumed during the look-back period	tCO_2/tonne of fuel	r	Each reporting period

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
EE_b	Energy emissions for PC production during the look-back period	tCO_2e	c	Each reporting period
CE_b	Calcination emissions for PC production during the look-back period	tCO_2e	c	Monthly
$EL_{b,production,\ grid}$	Grid electricity consumption for PC production during the look-back period	kWh	m	Monthly
$EF_{b,production,grid}$	CO_2 emission factor for grid electricity consumed during the look-back period	tCO_2/kWh	r	Each reporting period
$FC_{b,production}$	Fuel consumption for PC production during the look-back period.	tonnes of fuel	m	Monthly
$EF_{b,production,fuel}$	CO_2 emission factor for fuel consumed during the look-back period	tCO_2/ tonne of fuel	r	Each reporting period
$R_{b,clinker}$	Clinker to cement ratio for PC production during the look-back period	Percent	o	Each reporting period
EE_b	Energy emissions for PC production during the look-back period	tCO_2e	c	Each reporting period
$EF_{b,clinker}$	CO_2 emission factor for clinker during the reporting period from the most recent data.	tCO_2/ tonne of clinker	r	Each reporting period

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
d_b	Distance traveled for PC production during the look-back period	miles	m	Monthly
$EF_{b,transport}$	CO_2 emission factor for mode of transport during the look-back period from the most recent EPA Emission Factors for Greenhouse Gas Inventories. Projects shall use the CO_2 factor for the appropriate transportation mode.	tCO_2/ mile	r	Each reporting period
Q_{cement}	Quantity of material subjected to mineralization	tonnes	m	Monthly
$C_{sample,p}$	Carbon content in project sample		m	Monthly
$C_{sample,b}$	Carbon content in baseline sample		m	Monthly
$ME_{t,s}$	Mining emissions for SCM manufacturing during the reporting period for all eligible SCMs “s”	tCO_2e	c	Each reporting period
$PR_{t,s}$	Production emissions for SCM manufacturing during the reporting period for all eligible SCMs “s”	tCO_2e	c	Each reporting period
d_b	Distance traveled for PC production during the look-back period	miles	m	Monthly

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
$TE_{t,s}$	Transport emissions for SCM inputs to manufacturing, storage, additives, and waste during the reporting period for all eligible SCMs "s"	tCO_2e	c	Each reporting period
$AD_{t,s}$	Additive production and transportation emissions for SCM manufacturing during the reporting period	tCO_2e	c	Each reporting period
$EL_{t,mining,\ grid}$	Grid electricity consumption for SCM mining during the reporting period	kWh	m	Monthly
$EF_{t,mining,grid}$	CO_2 emission factor for grid electricity consumed during the reporting period	tCO_2/kWh	r	Each reporting period
$FC_{t,mining}$	Fuel consumption for SCM mining during the reporting period.	tonnes of fuel	m	Monthly
$EF_{t,mining,fuel}$	CO_2 emission factor for fuel consumed during the reporting period	tCO_2/ tonne of fuel	r	Each reporting period
$EL_{t,production,\ grid}$	Grid electricity consumption for SCM manufacturing during the reporting period	kWh	m	Monthly
$EL_{t,mining,\ grid}$	Grid electricity consumption for SCM mining during the reporting period	kWh	m	Monthly

Monitoring Parameters

Parameter	Description	Data Unit	Calculated(c) Measured (m) Reference(r) Operating Records (o)	Measurement Frequency
$EF_{t,production,grid}$	CO_2 emission factor for grid electricity consumed during the reporting period	tCO_2/kWh	r	Each reporting period
$FC_{t,production}$	Fuel consumption for SCM production during the reporting period.	tonnes of fuel	m	Monthly
$EF_{t,production,fuel}$	CO_2 emission factor for fuel consumed during the reporting period	tCO_2/ tonne of fuel	r	Each reporting period
$d_{t,s}$	Distance traveled for SCM manufacturing during the reporting period	miles	m	Monthly
$EF_{t,s,transport}$	CO_2 emission factor for mode of transport during the reporting period	tCO_2/ mile	r	Each reporting period
$Q_{t,ad}$	Quantity of additives used during the reporting period	tonnes	m	Quarterly
$EF_{t,a}$	CO_2 emission factor for additive production during the reporting period	tCO_2/tonne of additive	r	Each reporting period

Reporting Parameters

Project developers must provide the following documentation to the Reserve in order to register a low carbon cement project:

- Project Submittal form
- Signed Attestation of Title form
- Signed Attestation of Voluntary Implementation form
- Signed Attestation of Regulatory Compliance form
- Verification Report
- Verification Statement

Project developers must provide the following documentation each reporting period in order for the Reserve to issue CRTs for quantified GHG reductions:

- Verification Report
- Verification Statement
- Signed Attestation of Title form
- Signed Attestation of Voluntary Implementation form
- Signed Attestation of Regulatory Compliance form

Reporting Parameters

For purposes of independent verification and historical documentation, project developers are required to keep all information outlined in this protocol for a period of 10 years after the information is generated or 7 years after the last verification.

System information the project developer must retain includes:

- All data inputs for the calculation of the project emission reductions
- Documentation for the quality and quantity of eligible SCMs/ACMs
- Documentation for the quantity of additives
- Copies of all solid waste, air, water, and land use permits, Notices of Violations (NOVs), and any administrative or legal consent orders dating back at least five years prior to the project start date, and for each subsequent year of project operation
- Executed Attestation of Title, Attestation of Regulatory Compliance, and Attestation of Voluntary Implementation form

Reporting Parameters

Reporting Period:

- Project developers must report GHG reductions resulting from project activities during each reporting period.
- A reporting period may not exceed 12 months in length, except for the initial reporting period, which may cover up to 24 months.
- The Reserve accepts verified emission reduction reports on a sub-annual basis, should the project developer choose to have a sub-annual reporting period and verification schedule (e.g., monthly, quarterly, or semi-annually).
- Reporting periods must be contiguous; there must be no gaps in reporting during the crediting period of a project once the first reporting period has commenced.

Verification Period:

- The initial verification period for a low-carbon cement project is limited to one reporting period of up to 24 months of data.
- Subsequent verification periods may cover up to two reporting periods, with a maximum of 24 months of data (i.e., 12 months of data per reporting period).
- To meet the verification deadline, the project developer must have the required verification documentation (see Section 7.1) submitted within 12 months of the end of the verification period.

Reporting Parameters

Verification Site Visit:

- A site visit must occur during the initial verification, and at least once every two reporting periods thereafter. A reporting period may be verified without a new site visit if the following requirements are met:

  1. A new site visit occurred in conjunction with the verification of the previous reporting period;
  2. The current verification is being conducted by the same verification body that conducted the site visit for the previous verification; and
  3. There have been no significant changes in data management systems, equipment, or personnel since the previous site visit.

- The above requirements apply regardless of whether the verification period contains one or two reporting periods.
- The Reserve maintains the discretion to require a new site visit for a reporting period despite satisfaction of the above requirements.
- Where does the site visit occur? SCM facility, PC facility, ready-mix facility, all of the above? Virtual?

Verification – Eligibility Requirements

Protocol Section	Eligibility Qualification Item	Professional Judgment?
2.1 – 2.3	Verify that the project meets the definition of an SCM project	No
2.1	Verify when the SCM manufacturing site is existing, upgraded, relocated or restarted	No
2.2	Verify ownership of the reductions by reviewing the Attestation of Title	No
3.1	Verify that the project only consists of activities at a SCM manufacturing site operating within the U.S. or its territories	No
3.2	Verify eligibility of project start date	No
3.2	Verify accuracy of project start date based on operational records	Yes
3.3	Verify that project is within its 10-year crediting period	No
3.4.1	Verify that the project meets the appropriate Performance Standard Test for the project type	No
3.4.2	Confirm executing of the Attestation of Voluntary Implementation form to demonstrate eligibility under the Legal Requirement Test	No
3.4.2	Verify the Monitoring Plan contains procedures for ascertaining and demonstrating that the project passes the Legal Requirement Test at all times	Yes
3.5	Verify that the project activities comply with applicable laws by reviewing any instances of non-compliance provided by the project developer and performing a risk-based assessment to confirm the statements made by the project developer in the Attestation of Regulatory Compliance form	Yes
3.6	Verify that the SCM/ACM meets any applicable ASTM International Standard.	No
6	Verify that monitoring meets the requirements of the protocol. If it does not, verify that a variance has been approved for monitoring variations.	No
n/a	If any variances were granted, verify that variance requirements were met and properly applied	Yes

Verification – Quantification

Protocol Section	Qualification Item	Apply Professional Judgment?
4	Verify that SSRs included in the GHG Assessment Boundary correspond to those required by the protocol and those represented in the project diagram for the reporting period	No
5	Verify that all SSRs in the GHG Assessment Boundary are accounted for	No
5	Verify that the baseline emissions are properly aggregated	No
5	Verify that the project developer received Reserve approval for using Approach 2 or Approach 3 in the baseline, if applicable	No
5	Verify that the project developer correctly calculated the PC weight adjustment factor	No
5	Verify that the baseline emissions were calculated according to the protocol with the appropriate data	No
5	Verify that the project emissions were calculated according to the protocol with the appropriate data	No
5	Verify that the project developer correctly monitored, quantified, and aggregated electricity use, if applicable	Yes
5	Verify that the project developer correctly monitored, quantified, and aggregated fossil fuel use, if applicable	Yes
5	Verify that the project developer applied the correct emission factors for fossil fuel combustion and grid-delivered electricity, if applicable	No
5	If default emission factors are not used, verify that project-specific emission factors are based on official audited emissions data	No
5	Verify that the appropriate calculations were performed by the project developer and quantification and equation processes were followed	No
5	Verify the additive emission were appropriately calculated and quantified, if applicable	No
5	Verify SCM/ACM displaced PC at cement facility or ready-mix concrete plant though review of sales receipts and sales volumes.	Yes

Verification – Risk Assessment

Protocol Section	Item that Informs Risk Assessment	Apply Professional Judgment
6	Verify that the project Monitoring Plan is sufficiently rigorous to support the requirements of the protocol and proper operation of the project	Yes
6	Verify that the individual or team responsible for managing and reporting project activities are qualified to perform this function	Yes
6	Verify that appropriate monitoring equipment is in place to meet the requirements of the protocol	Yes
6	Verify that appropriate training was provided to personnel assigned to GHG reporting duties	Yes
6	Verify that all contractors are qualified for managing and reporting GHG emissions if relied upon by the project developer. Verify that there is internal oversight to assure the quality of the contractor's work	Yes
6, 7	Verify that all required records have been retained by the project developer	No

FOLLOW-UP

Project Ownership

- Project developers may be SCM/ACM suppliers and manufacturers, low-carbon cement technology suppliers, or entities that specialize in project development.

- The project developer must have clear ownership of the project's GHG reductions. Ownership of the GHG reductions must be established by clear and explicit title, and the project developer must attest to such ownership by signing the Reserve's Attestation of Title form.

- The project developer must be the SCM/ACM **producer responsible for certifying that the SCM/ACM product meets ASTM standards** ~~entity with liability for the SCM/ACM project (i.e. **the entity named on the facility's ? permit**,)~~, unless the rights to the emissions reductions have been transferred to another entity.

  – How do we ensure that the SCM/ACM replaced PC and resulted in an actual GHG reduction?
    - Sale receipts
    - Sales volume
    - ASTM report
    - Others?

ASTM Standards

Eligible SCM/ACM	ASTM Standard Specifications	ASTM Standard Test Methods
Beneficiated ash	C618-22: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete	C311/C311M-22: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
Natural pozzolans	C618-22: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete	C311/C311M-22: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
Ground glass pozzolans	C1866/C1866M – 20: Standard Specification for Ground-Glass Pozzolan for Use in Concrete	C109/C109M, C311/C311M, C1069, C1293, C1567
Calcined clays/shale and/or metakaolin	C989/C989M-22: Standard Specification for Slag Cement for Use in Concrete and Mortars	
Limestone calcined clays	C595/C595M – 21: Standard Specification for Blended Hydraulic Cements	C109/109M, C114, C151,C151M, C183/C183M, C185, C187, C188, C191, C204, C311/C311M, C430, C1012/C1012M, C1038/C1038M
CO_2 / Biochar	Standard Specification for Cement that Hardens by Carbonation	Standard Test Methods for Cementitious Materials that Harden by Carbonation

ASTM Standards

Eligible SCM/ACM	ASTM Standard Specifications	ASTM Standard Test Methods
Ternary blends of a SCMs/ACMs listed above*	C595/C595M – 21: Standard Specification for Blended Hydraulic Cements	
Other artificial pozzolans or treated calcined materials (including rice husk ash)	C618 or C989 or other?	
Other waste by-products (including Bauxite residue (Red Mud), lime kiln dust, or cement kiln dust)	C618 or C989 or other?	
Manufactured ACMs	C618 or C989 or other?	
Hydroxide products (including portlandite ($Ca(OH)_2$) and brucite ($Mg(OH)_2$))	C618 or C989 or other?	
Other novel SCMs (including biogenic limestone)	C618 or C989 or other?	

Additionality – Legal Requirement Test

- The U.S. currently has no federal regulation, such as a cap-and-trade program or carbon tax, that requires GHG emission reductions in the cement industry. Nor are there any national laws that require the production of SCMs/ACMs, blended cement, or SCM/ACM concrete.
- To satisfy the Legal Requirement Test, project developers must submit a signed Attestation of Voluntary Implementation form prior to the commencement of verification activities each time the project is verified (see Section 8).
- State level considerations:
  - California's GHG cap-and-trade program applies to cement plants
  - California Department of Transportation (Caltrans) already sets minimum amounts of required SCMs in state pavement and structure applications. These minimum requirements include 20% to 25% natural pozzolan or fly ash, 12% silica fume or metakaolin, or 50% GGBFS.
  - New Jersey's concrete mandate (S3091/A4933) that incentivizes lower carbon concrete for state projects by offering a tax credit for builders.
  - North Carolina Coal Ash Management Act created a legal requirement that the "installation and operation" of three "ash beneficiation projects, each capable of annually processing 300,000 tons of ash to specifications appropriate for cementitious products."

Additionality – Performance Standard Test

- Using regional benchmarks conducted by NRMCA, the national average of cement used in the United States is approximately 81%, Portland cement, 14% fly ash cement and 4% slag cement.*
- Since silica fume is a niche product, it does not have a significant presence in the United States market. However, it is found to be readily available across the United States and common practice in specific situations.*
- Based on this market penetration to date, these products were found to be ineligible under this protocol.
- The Project Developer must demonstrate that the usage rate of the novel SCMs/ACMs in concrete is either near zero (first-of-its kind) and thus has insufficient data to calculate a penetration rate or provide evidence that production of the SCM/ACM product is less than 5% of PC production in the United States.

**References (NRMCA) to be added.*

Leakage

Leakage may occur if the project increases GHG emissions outside of the project's assessment boundary as a result of the project activity

1. Amount of OPC or clinker in the market is not reduced with accessibility to alternative SCM products (due to cost, quality of product, location, etc.)
2. How can we determine displacement of OPC – should there be a mechanism to determine this to avoid leakage? Sales receipt?
3. SCMs will increase rather than being diverted from one facility to another – therefore leakage risk is centralized on displacement of OPC in the market.
4. Mining and transportation leakage concerns are imbedded in baseline and project emission calculations
5. Inability to use many SCMs beyond a certain replacement rate before negatively impacting the performance of concrete (ASTM Standards)
6. Are there any other leakage risks associated with this protocol?

Equation 5.2 includes total quantity of OPC that would have been produced during the reporting period – does this protect against leakage concerns from displaced OPC?

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NEXT STEPS

Next Steps

- Email us with any feedback on topics discussed today
- **Need for additional workgroup meeting? Early April?**
- **Final comments/feedback on V3 of draft protocol by March 31, 2023 (two weeks)**
- Reach out any time to discuss protocol topics or process
- Protocol revisions by Reserve staff – *ongoing*
- ***Public Comment Period – April/May 2023***

Key contacts

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THANK YOU!