CLIMATE ACTION RESERVE

# Low-Carbon Cement v1.0

Workgroup Meeting #3
February 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

# AGENDA

- Protocol considerations
  - The GHG Reduction Project
    - Project Definition
    - Project Ownership
  - Eligibility Rules
    - Project Location
    - Start Date
    - Crediting period
    - Additionality
    - Regulatory Compliance
  - GHG assessment boundary
  - Quantification
  - Monitoring / Reporting / Verification
- Open Discussion
- Next steps

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# THE GHG REDUCTION PROJECT

# Project Definition

- **For the purpose of this protocol, the GHG reduction project is defined as the manufacturing of ~~upgraded or novel~~ SCMs or ACMs that can partially or fully replace Portland cement. The project results in the avoidance of GHG emissions from Portland cement production.**

- Portland Cement is defined by the ASTM (C150 & C219) as a hydraulic cement produced by pulverizing clinker, consisting essentially of crystalline hydraulic calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 5 % limestone, and processing additions.

- SCMs are defined by the ASTM as a slag cement or pozzolan that contributes to the properties of concrete or mortar through hydraulic or pozzolanic activity or both; and meets one of two ASTM standards (ASTM C618, C989, or C1240)

- ACMs are defined by the ACI as non-portland cements including clinkered materials such as calcium-sulfoaluminate (CSA) and calcium-aluminate cements (CAC), calcined materials such as magnesium phosphate cement (MPC) and magnesium oxychloride cement (MO), non-clinker materials such as alkali- or chemically-activated silicates or aluminosilicates (AA) including geopolymers.

# Project Definition – Ineligible Products

The Reserve has identified products that are **ineligible** under the protocol. This version of the protocol does not apply to the production of:

1. Portland Limestone Cement (PLC)
2. Traditional fresh fly ash
3. Traditional GGFC

# Project Definition - Eligible Products

- Beneficiated ash (upgraded / harvested)*
- Silica Fume
- Natural pozzolans (i.e. volcanic ash)
- Ground glass pozzolans
- Calcined clays/shale and metakaolin
- Limestone calcined clays
- Ternary blends
- $CO_2$
- Other artificial pozzolans or treated calcined materials (including rice husk ash and biochar)
- Other waste by-products (including Bauxite residue (Red Mud), lime kiln dust, or cement kiln dust)
- Manufactured ACMs (including clinkered, calcinated and non-clinkered ACMs)
- Hydroxide products (including portlandite and brucite)
- Other novel SCMs (including biogenic limestone)

# 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 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
    - Actual sales volume
    - Other options?

# Project Ownership - Aggregation

Combining multiple actors, activities, and locations into a single “project” for purposes of monitoring, reporting, verification, and credit issuance.

Should projects be allowed to aggregate and under what conditions?

- Suggestion that aggregation be based on product similarity according to $CO_2$ reduction (at same or different locations)
- This would mean products with different $CO_2$ reductions (even if a similar product type) would not be allowed to aggregate and would need to be two separate projects
- Thoughts?

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# ELIGIBILITY RULES

# Location, Start Date and Crediting/Reporting Period

## ➢ Location

Under this protocol, projects located in the United States, U.S. tribal lands and territories are eligible to register with the Reserve.

## ➢ Start date

First date that production of SCM for which credit issuance is sought

## ➢ Crediting period

10 years, renewable for another 10 year crediting period

## ➢ Reporting period

Flexible, based on SCM production, with maximum of 12 months

# 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

- **To inform the Performance Standard Test, the Reserve typically undertakes an assessment of prevailing practice in the specific industry and jurisdiction in question, which includes assessing drivers of adoption for a given practice or technology, as well as what the barriers to adoption might be.**

- **Current Industry Practice for Use of SCM/ACM in Concrete in the United States**

  – Upgraded and novel SCMs are currently uncommon in the cement and concrete industry as they face multiple barriers as discussed in Section B.3.

- **Barriers for Adopting SCMs/ACMs in the United States**

  – Increasing the use of SCMs faces several barriers that can be alleviated through carbon finance. These barriers can be broadly categorized into financial, technical, institutional, and market barriers, which will each be discussed in-turn in this section.

# Beneficiated Ash – What is eligible?

- Fresh fly ash is ineligible
- Non-spec ash mixed with spec ash is ineligible
- Harvested ash that has been in a landfill for ***X*** time is eligible
- Non-spec ash is eligible… what specs/tests?

# ASTM Quality Standards – Beneficiated Ash

*Chemical Requirements*

- Silicon dioxide (SiO2) plus aluminum oxide (Al2O3) plus iron oxide (Fe2O3),min, < 50%
- Calcium oxide (CaO), %
  - F >18%
  - C < 18%
- Sulfur trioxide (SO3), max, > 5%
- Moisture content, max, > 3 %
- **%Loss on ignition, max, > 6%**

Beneficiation

- Silicon dioxide (SiO2) plus aluminum oxide (Al2O3) plus iron oxide (Fe2O3),min, > 50%
- Calcium oxide (CaO), %
  - F < 18%
  - C < 18%
- Sulfur trioxide (SO3), max, < 5%
- Moisture content, max, < 3 %
- **%Loss on ignition, max, < 6%**

# ASTM Quality Standards – Beneficiated Ash

*Physical Requirements*

- Fineness > 34%
- Strength activity index:A not 75B
- Water requirement, max, percent of control > 105%
- Uniformity Requirements
  - Density, max variation from average, > 5%
  - Percent retained on 45-μm (No. 325), > 5%

Beneficiation

- Fineness < 34%
- Strength activity index:A 75B
- Water requirement, max, percent of control < 105%
- Uniformity Requirements
  - Density, max variation from average, < 5%
  - Percent retained on 45-μm (No. 325), < 5%

# ASTM Quality Standards

- "Eligible projects must meet applicable **ASTM Standards** ~~SCM or ACM requirements in the region~~."
- Propose an additional section (Section 3.6) in the Draft Protocol – "ASTM Quality Standards"

- Is there an ASTM certification that DOT and others review?

- Should the standard be % loss of ignition
  - ASTM C618 (6% (10% N?) max LOI)
  - AASHTO M295 (5% max LOI)
  - State DOTs (multiple with max LOI below 5%)

# Regulatory Compliance

- Focus is on laws/regulations related to SCM/ACM and Cement production
- Project activities must be in compliance with relevant laws and regulations
  - Air, water, safety, etc.
- Project developers must submit a singed Attestation of Regulatory Compliance form
- Feedstocks and end uses addressed largely through eligibility requirements
- The Workgroup has **not** identified any specific regulations for SCM/ACM production or its use in cement/concrete.

# End Uses

## End Uses

Eligible end uses for which SCM/ACM can reasonably displace clinker in Portland Cement, e.g., ready mix concrete, cement production, etc.

The Workgroup has **not** identified any ineligible end uses.

Potential for some state projects to be ineligible which would be determined during the Legal Requirement Test for additionality.

I.e., Requirement for coal ash to be harvested and used in concrete production.

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# GHG ASSESSMENT BOUNDARY

# The GHG Assessment Boundary

**Purpose**

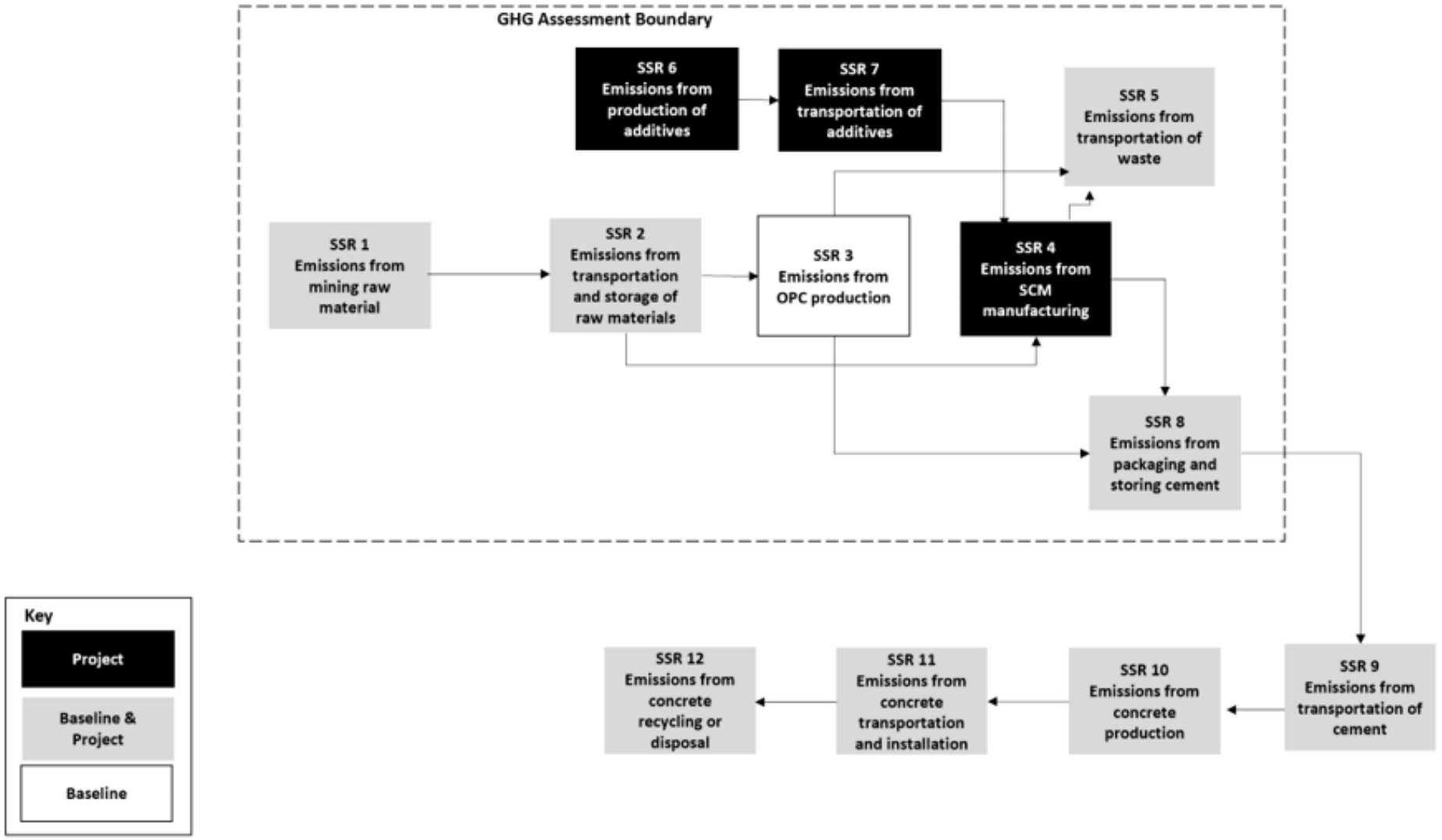
Account for significant GHG impacts from the project activity relative to the baseline.

- Delineates the GHG sources, sinks, and reservoirs (SSRs) that shall be assessed by project developers in order to determine the total net change in GHG emissions caused by a low carbon cement project.

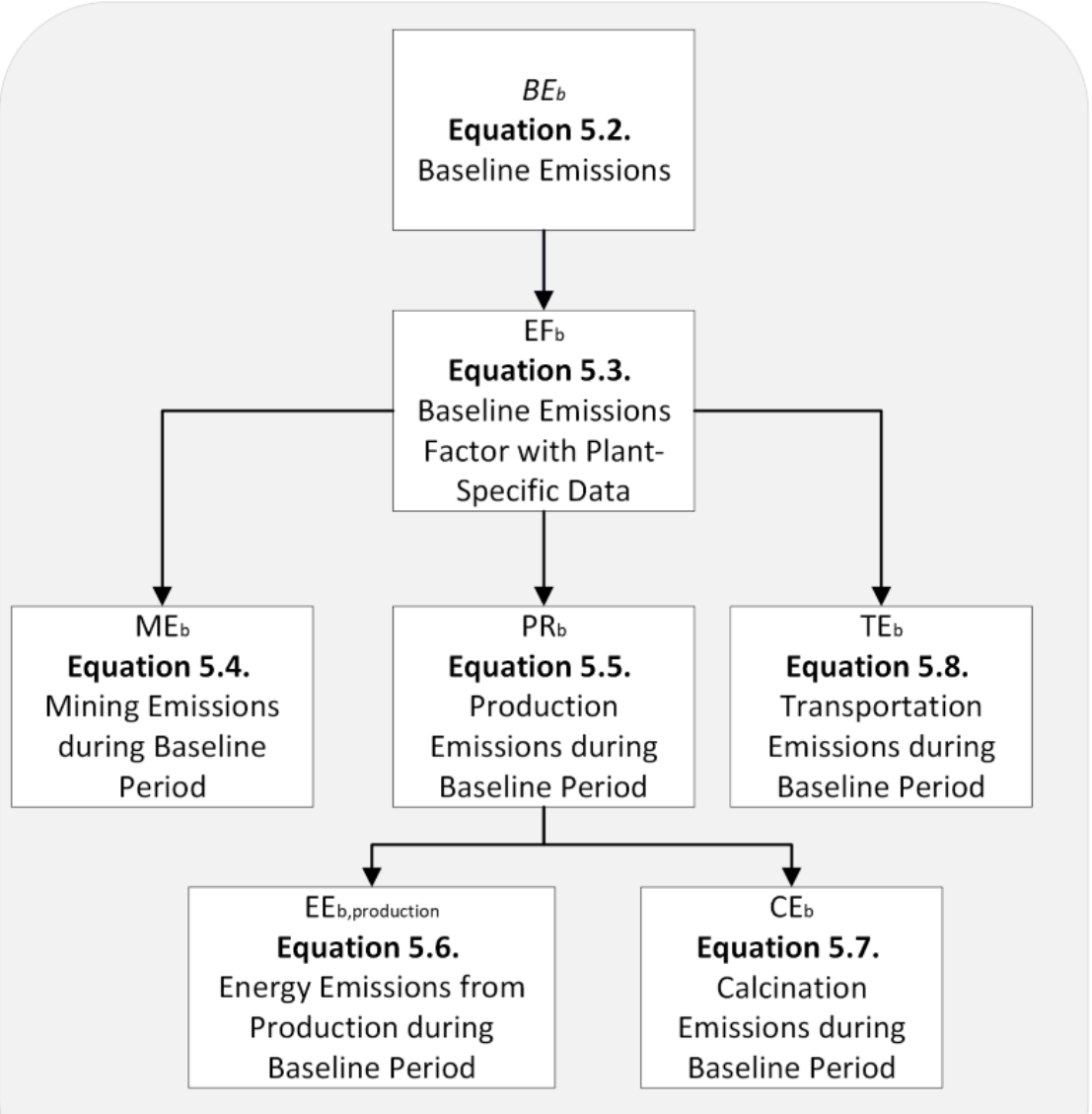
Scope includes feedstocks, production process, and end use

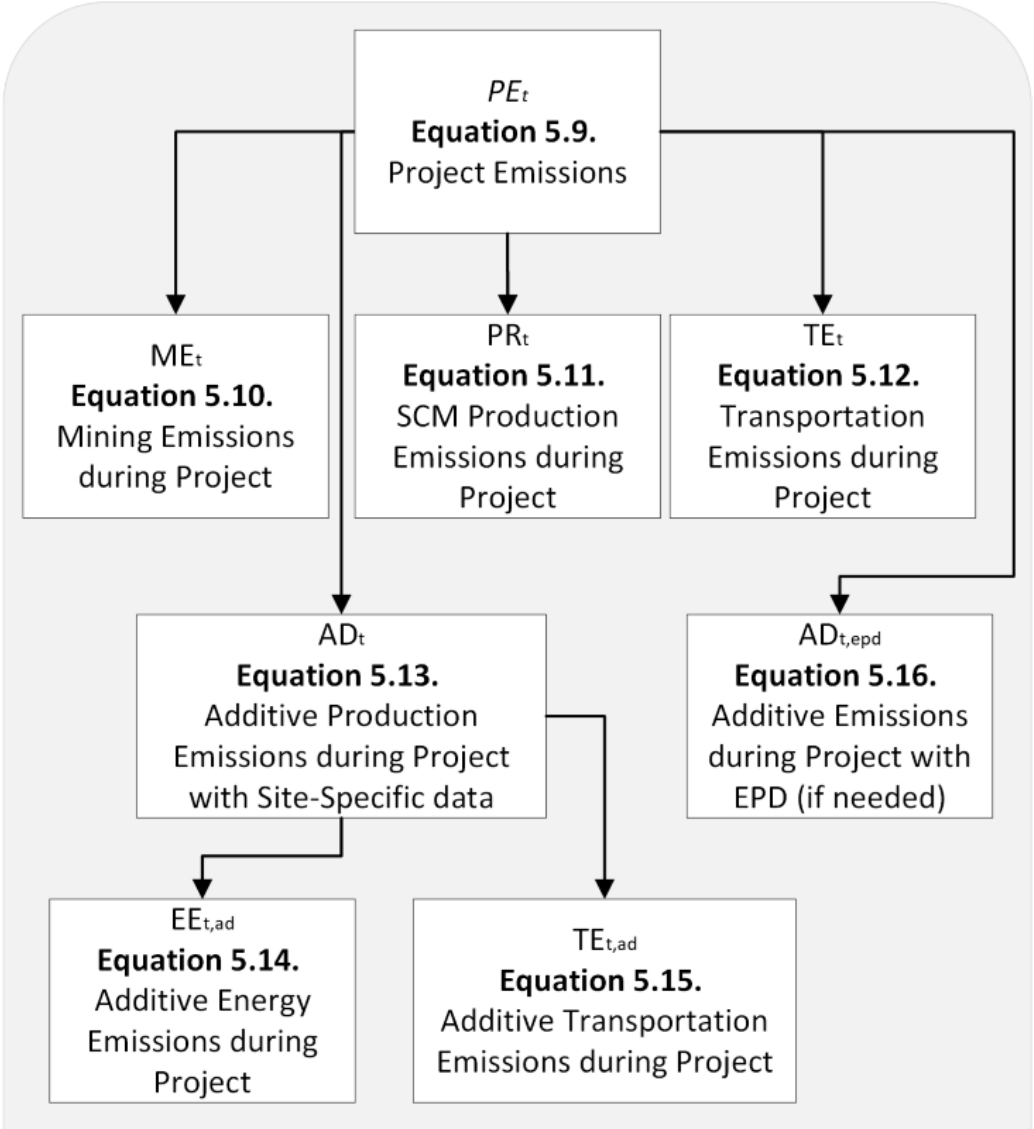
Inclusion of any individual SSR depends on project configuration and applicable baseline scenario.

# The GHG Assessment Boundary



# Quantification



# 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

## Baseline Emissions

Total emissions for production of OPC

- Mining emissions for OPC production
- OPC production emissions including calcination
- Transportation emissions for OPC production

$$BE = Q_b \times R_b \times EF_b$$

| *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 OPC that would have been produced during the reporting period. | tonnes |
| $R_b$ | = | OPC to SCM weight adjustment factor in period during the reporting period. | percent |
| $EF_b$ | = | $CO_2$ emission factor for OPC production during the reporting period. | $tCO_2e$/tonne of OPC |

# Quantification

## Baseline Emissions

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
   - Challenges if the project developer is not the OPC manufacturer
2. **Estimated emission factor using Environmental Product Declarations (EPDs)**
   - **Publicly available data for each location?**
3. Published emission factor using regional data

Availability of this data and/or ability for industry to publicly or confidentially share data?

# 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

$$PE = \sum_{s} ME_{t,s} + PR_{t,s} + TE_{t,s} + AD_{t,s}$$

| *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". | $tCO_2e$ |
| $AD_{t,s}$ | = | Additive production emissions for SCM manufacturing during the reporting period. | $tCO_2e$ |

# Quantification

## Project Emissions

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

# 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.
- For example, if a product is made up of 4.5% gypsum, 2% lime, and 1.5% other activators for a total of 8% additives.
  - The project proponent would be required to quantify emissions from the production of the primary additive (gypsum).
  - Since the secondary additives (lime and other activators) make up less than 5% of the weight of the final SCM product, their emissions may be excluded from the calculation as they would be considered negligible.

**Is 5% the correct limit? Why or why not?**

# 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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# MONITORING, REPORTING AND VERIFICATION

# Monitoring / Reporting / Verification (MRV)

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

# Monitoring / Reporting / Verification (MRV)

- Chain-of-custody tracking to document transfers from feedstock source to SCM producer to end use
- Standardized quantification/reporting tool to streamline reporting and verification
- Require physical verification site visits during initial verification and at least once every two reporting periods thereafter
- Can we leverage existing certification programs (e.g., ASTM standards, other standards?) to streamline our MRV process, including demonstration that some eligibility requirements have been met? Devil will be in the details.

# OPEN DISCUSSION – FEEDBACK AND SUGGESTIONS

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# NEXT STEPS

# Next Steps

- Email us with any feedback on topics discussed today
- **Submit comments/feedback by March 3rd, 2023**
- Reach out any time to discuss protocol topics or process
- Protocol revisions by Reserve staff – *ongoing*
- ***Share protocol draft with workgroup***
- ***Workgroup Meeting 4 – March 2023***
  - Review draft protocol, section by section
  - ~2-4 hour session via Zoom

# Key contacts

## Protocol development lead:

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## General inquiries:

Policy@climateactionreserve.org

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# THANK YOU!