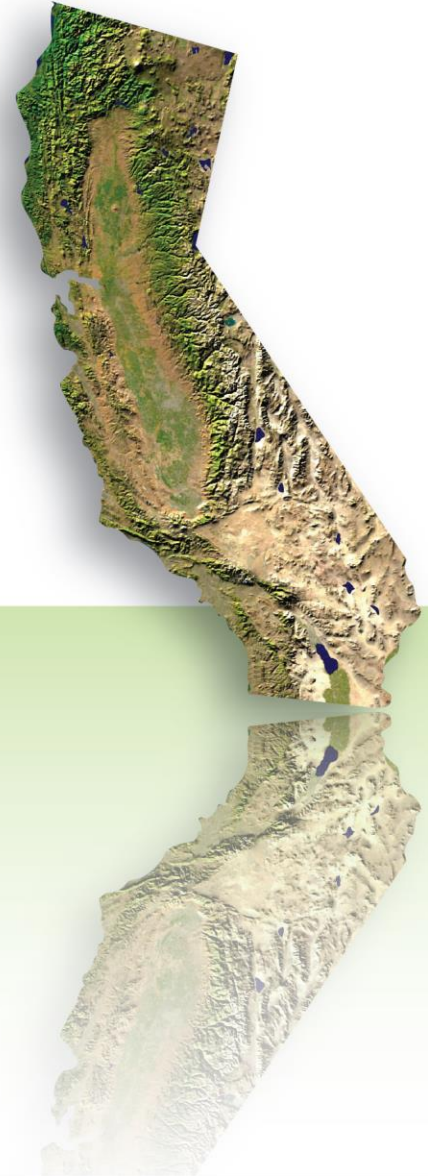


# Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting



Process Emissions Specialty  
Course 4.1: Cement Production

California Environmental Protection Agency

 **Air Resources Board**

# Welcome and Introductions

- Chris Halm, Lead ARB staff for Process Emissions Specialty
  - [chalm@arb.ca.gov](mailto:chalm@arb.ca.gov), 916-323-4865
- The Climate Registry Team
  - William (Bill) Master - Direct Path Strategies, Inc.
  - John Kline – Cement expert



# MRR Verifier Accreditation:

## Course Content and Exams

Course 1: General Verification for Mandatory GHG Reporting

Course 2: Transactions Specialty

Course 3: Oil and Gas Systems Specialty

Course 4: Process Emissions Specialty

4.1 Cement Production

4.5 Iron and Steel Production

4.2 Lime Manufacturing

4.6 Pulp and Paper Manufacturing

4.3 Glass Manufacturing

4.7 Lead Production

4.4 Nitric Acid Production

# Process Emissions Specialist

Provides verification services to operators of facilities engaged in

§95110 - Cement production (9)

§95116 - Glass production (10)

§95117 - Lime manufacturing (<3)

§95118 - Nitric acid production (<3)

§95119 - Pulp and paper manufacturing

(7 recycled paper plants - no pulp plants in CA)

§95120 - Iron and steel production (<3)

§ 95124 - Lead production (<3)

# Disclaimer

This accreditation training is intended to provide administrative detail and recommended practices for compliance with the verification provisions of the California Air Resources Board's (ARB) Regulation for the Mandatory Reporting of Greenhouse Gas (GHG) Emissions (Regulation) (Title 17, California Code of Regulations, sections 95100- 95158).

Unlike the Regulation itself, this training and associated materials do not have the force of law. The training and associated materials are not intended to and cannot establish new mandatory requirements beyond those that are already in the regulation, and they do not supplant, replace or amend any of the legal requirements of the regulation. Conversely, any omission or truncation of regulatory requirements does not relieve verification bodies, lead verifiers, verifiers of emissions data reports, or reporting entities of their legal obligation to fully comply with all requirements of the regulation.

*Note: ARB verification accreditation exams are not limited to this verification accreditation training or associated materials. The exams may test on anything contained in the regulation, this accreditation training, and associated materials.*



# Course 4.1 Handouts

4.1.1 Cement and Lime Mass Balance Calculation Workbook

4.1.2 Cement Case Study Handout

# Course 4.1 Cement Production

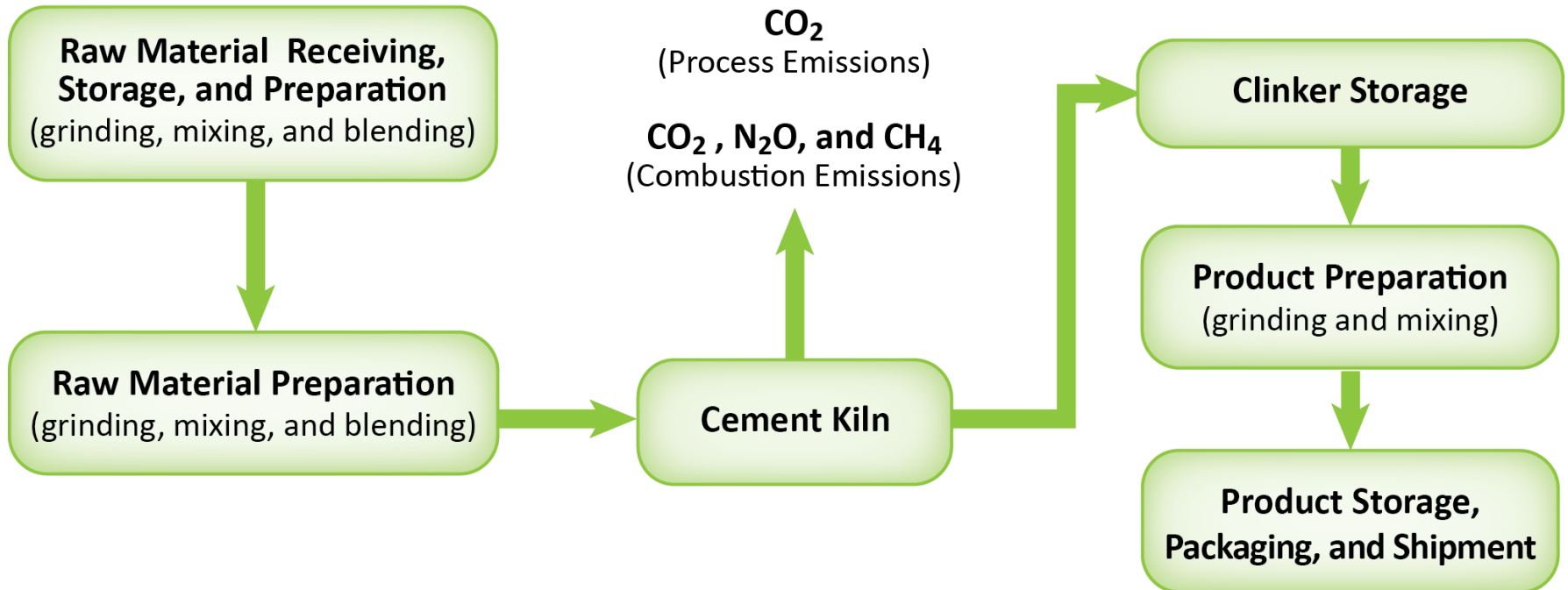
- 1. Overview**
- 2. Emissions Data**
- 3. Calculation Methods**
- 4. Verifying Emissions**
5. Product Data
6. Case Study

# § 95110 Cement Production

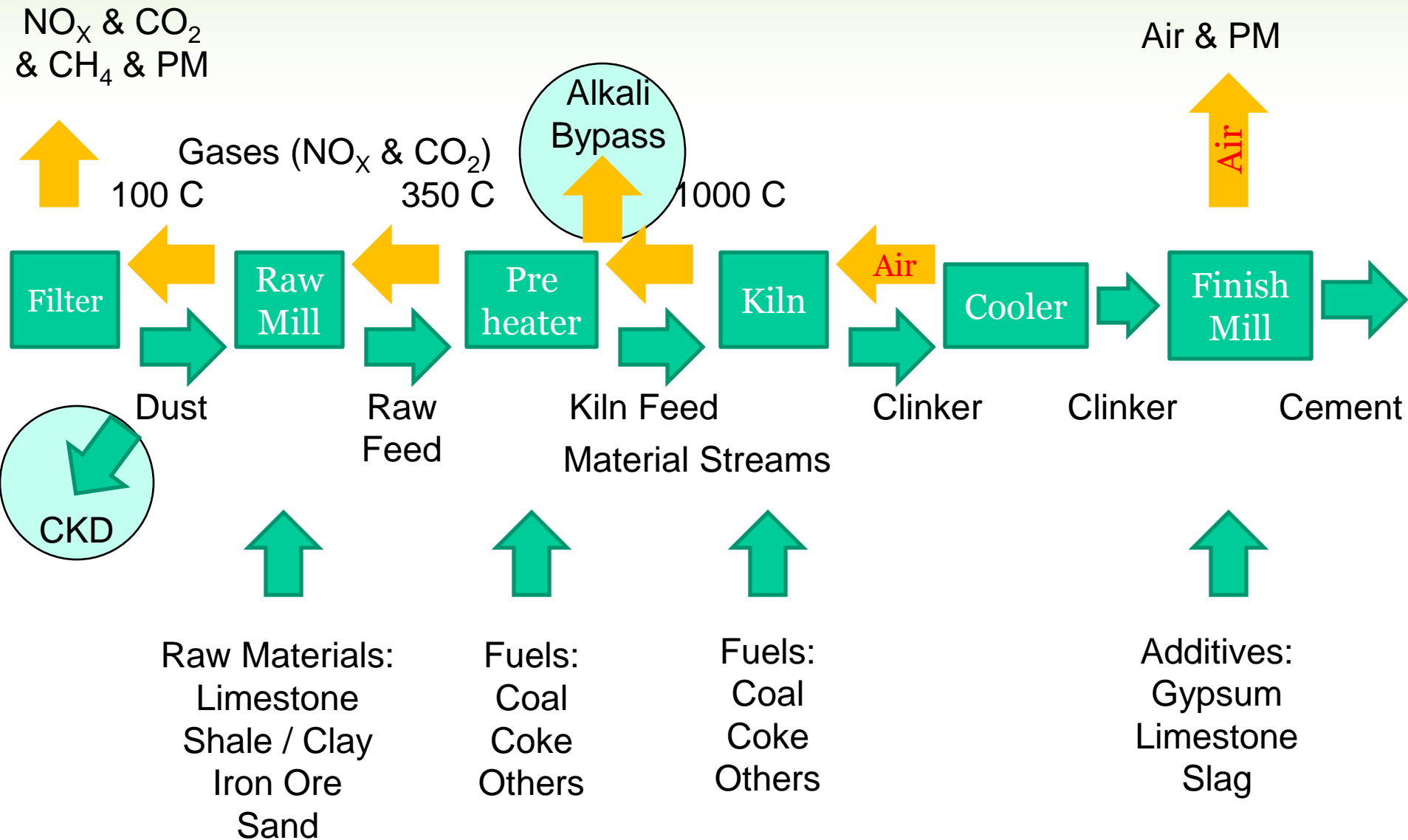
- Portland cement production facilities
  - Kilns and in-line kiln/raw mills
  - Alkali bypasses
- No reporting threshold
- $\geq 25,000$  MTCO<sub>2</sub>e triggers
  - Verification
  - Cap-and-Trade covered entity



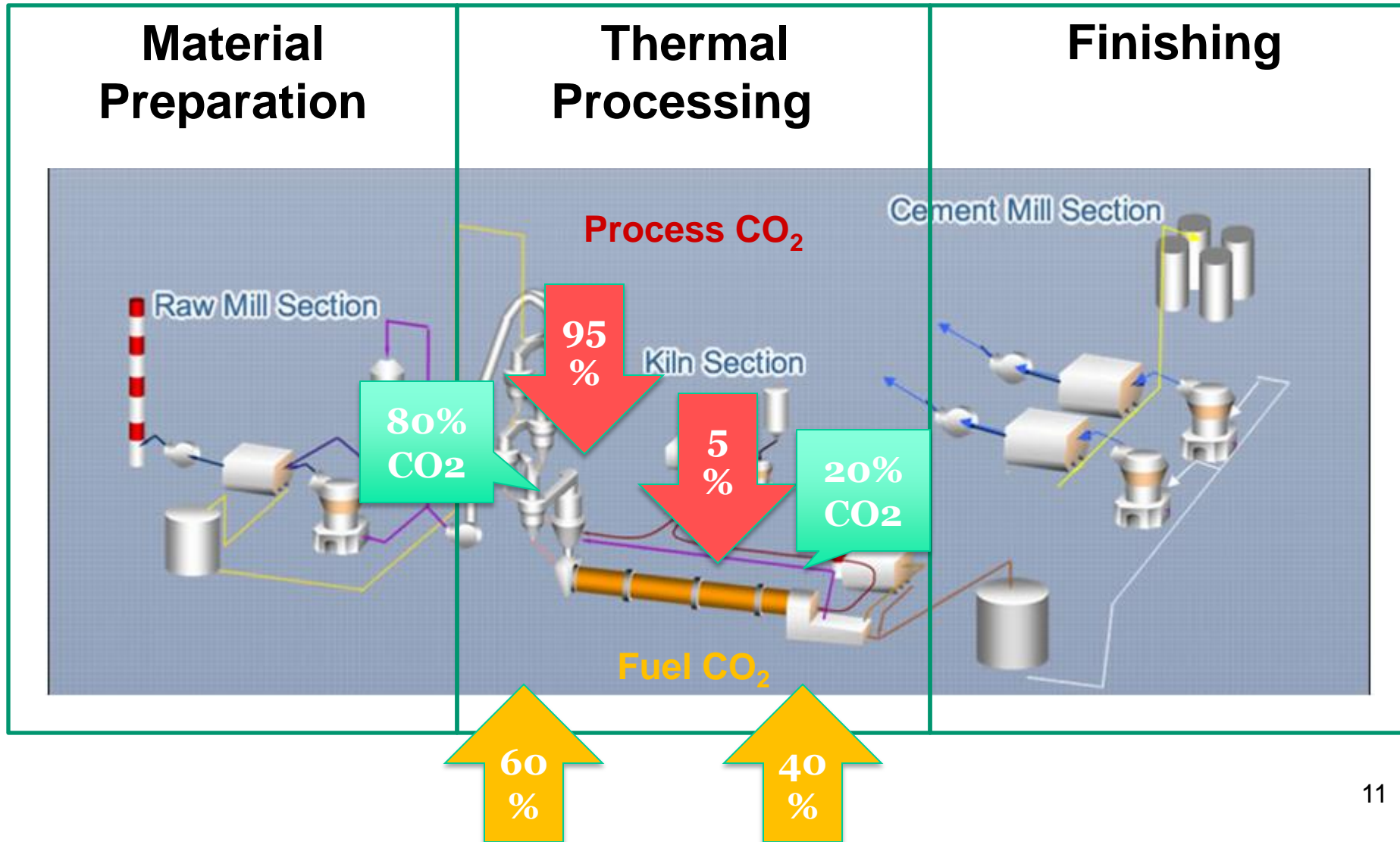
# Material Flow at a Cement Plant



# Cement Manufacturing Process



# Cement Manufacture - Precalciner



# Rules of Thumb

## Production Ratios (Approximate)

- 1.55 tons of dry raw material per ton of clinker
- 1.1 tons of cement per ton of clinker
- 1 ton of fuel per 10 tons of clinker produced
- 0.75 tons of CO<sub>2</sub> per ton of clinker produced

# Emissions Data Reported for Cement Production Facilities (1 of 2)

These emissions must be reported:

- CO<sub>2</sub> process emissions from cement kilns and in-line kiln/raw mills ( § 95110)
- CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from stationary combustion of fuels in cement kilns and in-line kiln/raw mills ( § 95115)
- CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from all other stationary combustion sources (e.g., dryers, process heaters, electricity generation, cogeneration supplemental firing) ( § 95112, 95115)

# Emissions Data Reported for Cement Production Facilities (2 of 2)

- All process emissions assumed to occur in precalciner and kiln
- No process emissions are assumed for the following:
  - Quarrying, material extraction and transport
  - Raw material handling and grinding
  - Clinker coolers and associated equipment
  - Product blending/grinding
  - Load out and transportation of finished goods

## § 95110 Relation to Subpart H

- Section 95110 refers to Subpart H for all reporting requirements, including CO<sub>2</sub> CEMS data, except
  - Follow § 95115 (c) on allowable Tiers (1-3) for non-CEMS stationary fuel combustion emissions
- Missing data substitution
  - § 95110 missing data only includes provisions for mass-balance calculation
  - § 95110 refers to § 95129 missing data for SFC sources
  - Subpart H refers to Subpart C or Part 75 for missing CEMS data
- Covered product data reporting requirements contained in § 95110

# Calculation Methods for CO<sub>2</sub> Process Emissions from Cement Kilns

Reporters must use one of the two methods specified in Subpart H for estimating emissions:

- CEMS
  - Report CO<sub>2</sub> from both combustion and process combined
- Mass balance calculation based on production data and composition analysis of clinker, CKD, and raw materials
  - Report CO<sub>2</sub> from combustion and process separately

*Note: All cement kilns reporting in California use CEMS to monitor CO<sub>2</sub> emissions*

# Common Issues with CEMS Reporting

- Gas flow meter accuracy
- CEMS CO<sub>2</sub> concentration - % accuracy
- H<sub>2</sub>O corrections
- CEMS software focused on generating quarterly compliance reports, but may not be transparent for verification

# Verifying CO<sub>2</sub> Emissions from Cement Kilns that use CEMS

- Review records of dates and results of CEMS certifications and quality assurance procedures performed during each reporting year
  - Linearity checks
  - Cylinder gas audits
  - Relative accuracy test audits (RATA)
- Determine whether the CEMS certifications and quality assurance procedures conform with the relevant requirements
  - 40 CFR Part 60 or Part 75
  - Air District Monitoring Program using CEMS

# Verifying Missing Data Substitution for CO<sub>2</sub> Emissions Measured with CEMS (1 of 2)

## Evidence to request

- Operator of a unit monitoring and reporting emissions and heat input data under §95115 using Tier 4 (40 CFR 98.33(a)(4)) must follow the missing data procedures in 40 CFR 75.31 to 75.37
- CEMS certified under 40 CFR Part 60 uses quality-assured data defined according to QA/QC procedures in Part 60
- Operators with an unforeseen CEMS breakdown resulting in >10% loss of emissions data may request ARB approval of an interim procedure ( §95129(i))

# Verifying Missing Data Substitution for CO<sub>2</sub> Emissions Measured with CEMS (2 of 2)

## How to evaluate the evidence

- Verify that missing data substitution procedures conform with the applicable procedures in 40 CFR Part 75
- If there was a CEMS breakdown, verify that
  - The reporter followed applicable procedures during the breakdown period, or
  - The reporter requested and received ARB approval to use interim data procedures during the breakdown period

# Reporting CO<sub>2</sub> Combustion Emissions from Mixed Fuels Using CEMS (1 of 2)

$$\text{Total CO}_2 = \text{Covered CO}_2 + \text{Exempt CO}_2$$

or

$$\text{Exempt CO}_2 = \text{Total CO}_2 - \text{Covered CO}_2$$

*[Note: “Covered” CO<sub>2</sub> equals Non-exempt CO<sub>2</sub> + Process CO<sub>2</sub>]*

## Three options

**Option 1** - Directly measure quantities of biomass fuels combusted to determine biogenic CO<sub>2</sub>

- Subtract only fuel quantities that are accurate

# Reporting CO<sub>2</sub> Emissions from Mixed Fuels Using CEMS (2 of 2)

## **Option 2** - Sample flue gas to determine biogenic CO<sub>2</sub>

- Conduct accurate and representative quarterly stack sampling (ASTM D6866-08) to determine biogenic fraction (as a percentage of total flow)
- Added expense, and might not detect low biogenic fraction
- Relieves requirement for biomass fuel measurement accuracy

## **Option 3** - Report all CO<sub>2</sub> from CEMS as covered emissions

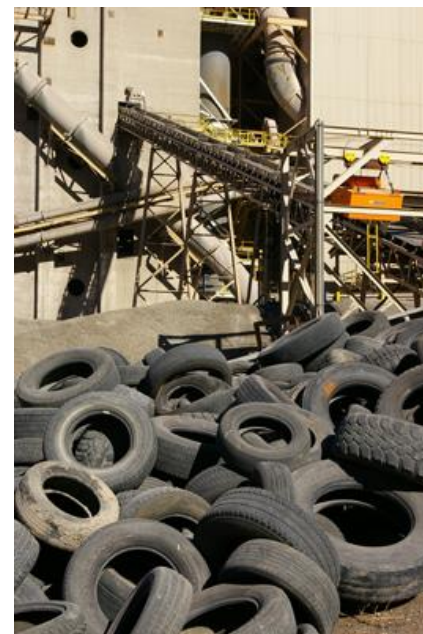
- If quarterly biogenic sampling is not representative and amount of exempt fuel is not accurately known, all emissions are assumed to be fossil /covered emissions

# Fuels for Cement Manufacture

- Cement companies pay for most fuels
  - The exception is waste fuels provided at no cost or where there may be a tipping fee paid to the cement plant
  - Therefore, fuel accounting is typically auditable and meets financial transaction criteria for accuracy
- Fuel inventory levels are generally low in plants, especially for waste fuels, so inventory adjustments may be small
- Moisture content of the fuel can be an issue
  - Accurate moisture values need to be established

# Emissions from Waste Tires

- Waste tires are burned at 5 out of 9 cement plants
  - Very high energy, low-cost fuel
- Similar reporting requirements to other fuels
  - Regulation allows a default of 20% biogenic
  - Monthly fuel sampling is allowed if a default is not used, but sampling is difficult and may not be representative
  - Tire purchases might not match amount of tires combusted, unless transaction occurs at the point of delivering fuel into kiln



# Course 4.1 Cement Production

1. Overview
2. Emissions Data
3. Calculation Methods
4. Verifying Emissions
- 5. Product Data**
- 6. Case Study**

# Covered Product Data § 95110(d)

Requires conformance with +/- 5% accuracy on each measurement and material misstatement evaluation on sum of the following (short tons):

- Annual clinker produced
- Annual clinker consumed
- Annual limestone consumed for blending
- Annual gypsum (natural and synthetic) consumed for blending

**CEMENT IS NOT A COVERED PRODUCT!**

Annual cement substitute is reported but not “covered”

Note: covered product data for cement plants may not be excluded

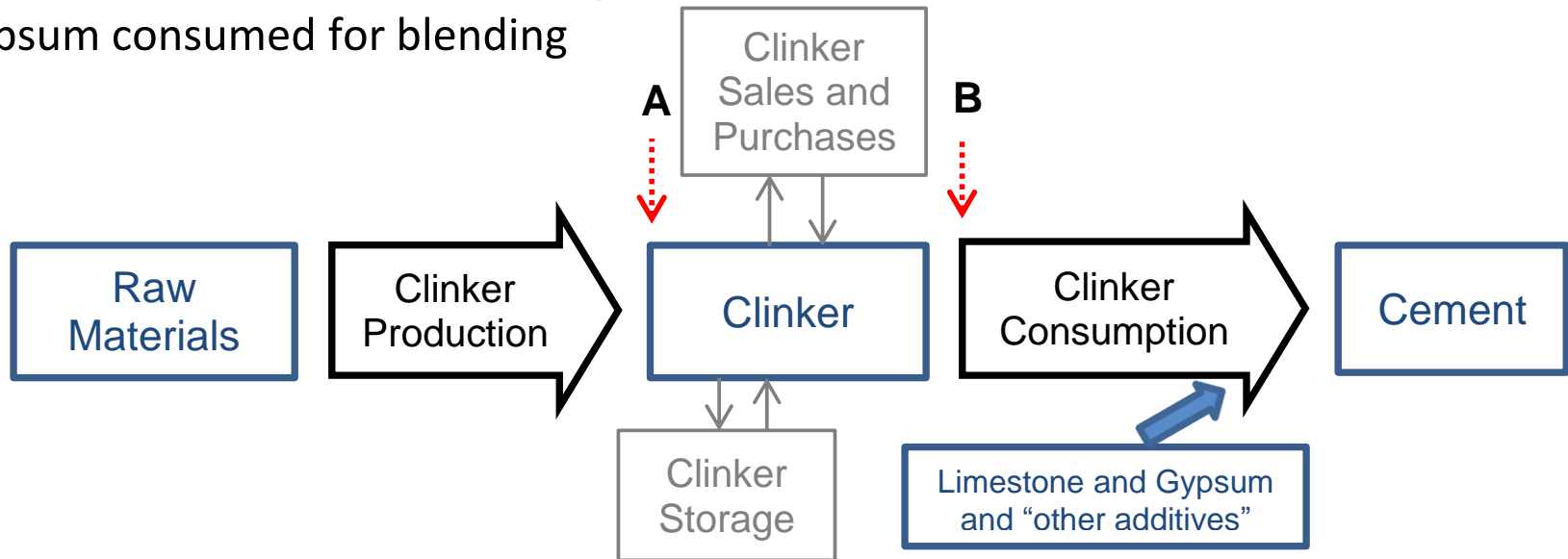
# Covered Product Data from Cement Plants: Illustrative Example (Part 1)

Clinker produced

Clinker consumed

Limestone consumed for blending

Gypsum consumed for blending



- Measurement point A - Clinker produced
- Measurement point B - Clinker consumed

# Verifying Covered Product Data: Evidence to Request

- Documentation describing how operator determined production quantities (GHG Monitoring Plan)
- Maintenance and calibration records for weighing scales
- Original records, weighing measurement records, sales receipts, and invoices
- Beginning and end of year inventory records
  - Cement, clinker, gypsum for blending, limestone for blending
- If clinker production is based on raw material feed measurements and a feed-to-clinker ratio, then request
  - Records of raw material consumption (direct measurement records/delivery receipts, etc.)
  - Clinker production/raw material consumption data used to determine monthly feed-to-clinker ratio

# Material Misstatement vs. Conformance for Covered Product Data for Cement Plants

- Material misstatement based on the sum of Clinker Produced + Clinker Consumed + Limestone and Gypsum Consumed for Blending
  - Material misstatement is only triggered if overall sum is not within +/- 5%
  - Note that Cement Substitutes consumed are not included in the material misstatement evaluation
- Any single covered product that is not measured accurately within +/-5% is a non-conformance ( § 95103(k), (k)(2)and(6))
  - Results in a qualified positive verification statement if discrepancy is not a material misstatement (and no correctable error is present)

# Cement Covered Product Data Reporting Examples

- Annual data must be accurate
  - Monthly data can provide additional support on accuracy, but only annual data must be accurate
  - Verifiers will scrutinize entire process to determine conformance with regulation
  - During site visit, ensure all staff necessary to explain process are in attendance
  - Review whether methods have changed
- Following are two examples for reporting covered product data
  - See *Cement Producers Covered Product Data Reporting Guidance* on ARB website.

# Cement Covered Product Data Reporting

## Example 1

- Operator directly measures products using accurate and calibrated truck scales, weigh feeders, and belt scales or other meters
  - Other inventory measurements using tank drop and pile surveys must still be accurate (+/-5%)
- Good option for cement plants if measurement equipment is robust and appropriate

# Cement Covered Product Data Reporting

## Example 2

- Use cement sales and analysis data to back-calculate covered product data
- Adjust for beginning and ending cement inventory to ensure only covered products that are *produced during data year* are reported
- Review the accuracy of total cement produced

# Inventory Adjustments for Covered Product Data at Cement Plants

- Operators may calculate production using a backwards calculation from cement sold
  - Cement sold is typically weighed on regulated truck scales
- Accurate inventory adjustments are necessary as large quantities of cement and clinker storage are common
  - Cement is usually stored in silos, clinker can be stored in silos, domes, and / or storage buildings and outside piles
  - The larger the ratio of sales-to-storage volumes, the relatively smaller the estimated inventory adjustment will be to the reported data; however, accurate measurement is still required for conformance

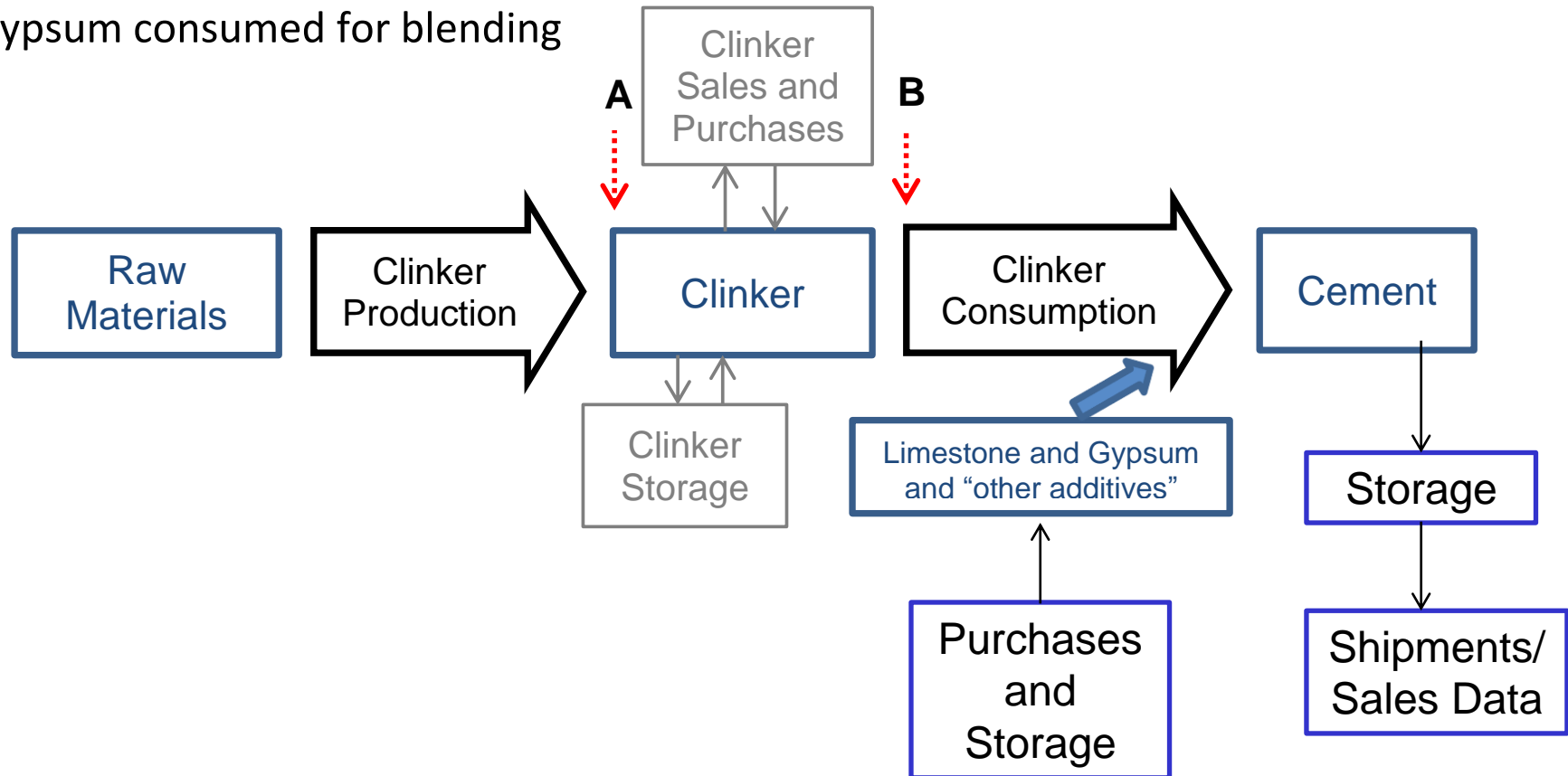
# Covered Product Data from Cement Plants: Illustrative Example (Part 2)

A-Clinker produced

B-Clinker consumed

Limestone consumed for blending

Gypsum consumed for blending



# Production Check (Backwards Calculated) <sup>1</sup>

<b>Cement Sold</b>	1,200,000	Tons	Plant Data
Inventory Period Beginning	75,000	Tons	Plant Data
Inventory Period End	50,000	Tons	Plant Data
Cement Produced	1,175,000	Tons	Sold + End - Beginning

<b>Cement Additives Purchased</b>	100,000	Tons	Plant Data
Inventory Period Beginning	15,000	Tons	Plant Data
Inventory Period End	10,000	Tons	Plant Data
Cement Additives Consumed	105,000	Tons	Purchased + Beginning - End
Average Moisture Level	5.0%		Plant Data
Dry Additives Consumed	99,750	Tons	Consumed * (1 - H2O%)
Clinker Consumed	1,075,250	Tons	Cement Produced - Dry Additives

<b>Clinker Consumed</b>	1,075,250	Tons	Plant Data
Inventory Period Beginning	60,000	Tons	Plant Data
Inventory Period End	40,000	Tons	Plant Data
Clinker Produced	1,055,250	Tons	Consumed + End - Beginning

<sup>1</sup>See the cement – lime mass balance calculation handout 4.1.1.

# Verifying Other Data for Cement Plants

- “Production-related” data
  - 40 CFR 98 subpart H requires other production-related data to be reported to U.S. EPA: cement production
  - Production-related data  $\neq$  Covered product data
- *Other production-related data are not subject to the same requirements as covered product data required under MRR and listed in Table 9-1 of the Cap-and-Trade Regulation. However, the 40 CFR 98 production-related data elements must be verified for conformance.*
- If production-related data are used to calculate emissions (no CEMS), then they must be reviewed for accuracy and missing data and could influence the evaluation of material misstatement for emissions data.



# Case Study, Course 4.1 Cement Handout 4.1.2

See Handout

# Questions and ARB Comments

## Course 4: Process Emissions Specialty

***Complete:***

4.1 Cement Production

***Next:***

4.2 Lime Manufacturing

4.3 Glass Manufacturing

4.4 Nitric Acid Production

4.5 Iron and Steel Production

4.6 Pulp and Paper Manufacturing

4.7 Lead Production