SB 596 Cement Sector Net-zero Emissions Strategy Kick-off Workshop

OCTOBER 20, 2022

Agenda

- CARB staff presentation (9:10 am)
  - Overview of SB 596
  - Overview of California cement sector
  - Potential opportunities to reduce the GHG intensity of cement used within the state
- Panel presentations (9:40 am)
  - Tom Tietz, California Nevada Cement Association
  - Eric Trusiewicz, Stanford University
  - Sabbie Miller, UC Davis
  - Cody Finke, Brimstone
  - John O'Donnell, Rondo Energy
- Q&A and next steps (11:30 am)

Overview SB 596

SB 596: Long-Term Goal

- SB 596 (Becker, Chapter 246, Statutes of 2021), Section 38561.2(a)(1)
  - "By July 1, 2023, CARB shall develop a comprehensive strategy for the state's cement sector to achieve net-zero GHG emissions associated with cement used within the state as soon as possible, but no later than December 31, 2045."

SB 596: Interim Targets

- Section 38561.2
  - (a)(2). “CARB shall establish interim targets for reductions in the GHG intensity of cement used within the state…to 40 percent below the 2019 average levels by December 31, 2035.”
    - (b)(1). Define a metric for cement GHG intensity to establish a baseline for calendar year 2019
    - Data submitted to CARB by cement plants under the Mandatory Reporting Regulation (MRR)
    - Other relevant data for cement imported into the state

SB 596: Interim Targets cont'd

- Section 38561.2
  - (a)(4)(A). "By July 1, 2028, CARB shall evaluate the feasibility of achieving the interim targets… and may adjust the interim targets upward or downward to reflect technological advancements and progress..."
  - (a)(4)(B). "If CARB makes a downward adjustment…CARB shall document the feasibility constraints…and recommend measures and actions…to achieve net-zero emissions…no later than December 31, 2045."

SB 596: Timeline

- **July 1, 2023:** Develop a comprehensive strategy to achieve net-zero emissions for cement used within California by 2045
  - Define a metric for GHG intensity for cement used within California
  - Develop a GHG intensity baseline for cement used within California using 2019 data
- **July 1, 2028:** Assess the feasibility of achieving the interim targets
- **Dec 31, 2035:** Achieve interim target (40% below the 2019 average GHG intensity)
- **Dec 31, 2045:** Achieve net-zero emissions

SB 596: Comprehensive Strategy (1 of 3)

- Section 38561.2(b)
  - **(b)(2).** Assess existing measures, identify modifications to existing measures, and evaluate new measures to overcome market, statutory, and regulatory barriers
  - **(b)(5).** Coordinate and consult with other state agencies, districts, and experts in academia, industry, and public health, and with local communities

SB 596: Comprehensive Strategy (2 of 3)

- Section 38561.2(b)
  - **(b)(7).** Evaluate measures to support market demand and financial incentives to encourage the production and use of cement with low GHG intensity, including:
    - **(b)(7)(A).** Measures to expedite the adoption of Portland limestone cement and other blended cements in projects undertaken by state agencies
    - **(b)(7)(B).** Measures to provide financial support and incentives for RD&D of technologies to mitigate GHG emissions from cement production in order to accelerate deployment
    - **(b)(7)(C).** Measures to facilitate fuel switching
    - **(b)(7)(D).** Measures to create incentives and remove obstacles for energy efficiency improvements and waste heat recovery
  - **(b)(6).** Prioritize actions that leverage state and federal incentives

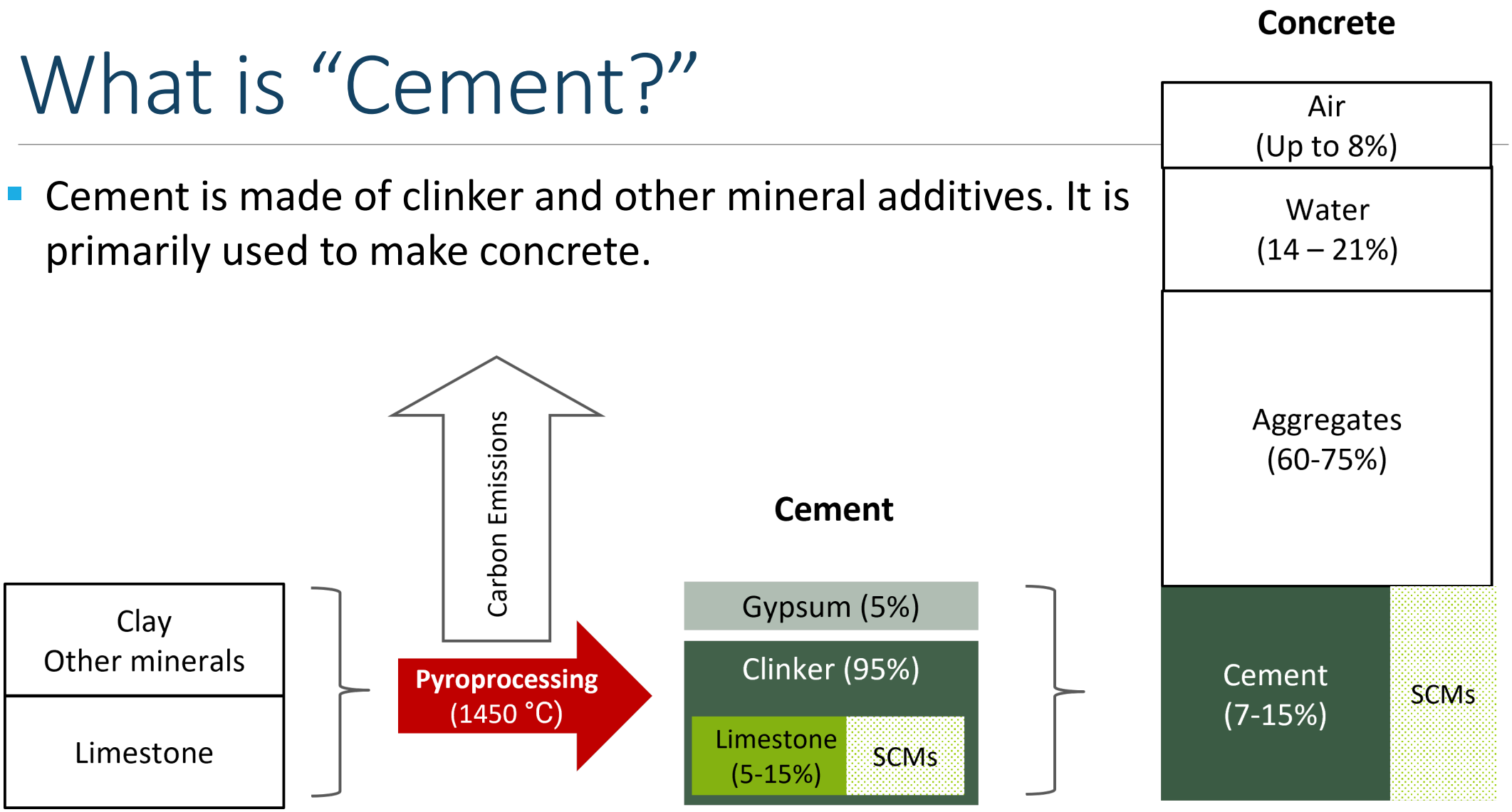
SB 596: Comprehensive Strategy (3 of 3)

- Section 38561.2(b)
  - **(b)(3).** Identify actions that reduce adverse air quality impacts and support economic and workforce development in communities neighboring cement plants
  - **(b)(4).** Include provisions to minimize emissions leakage and account for GHG emissions embedded in imported cement in a similar manner as GHG emissions from cement produced in the state, such as border carbon adjustment

Overview of California Cement Sector

What is “Cement?”

- Cement is made of clinker and other mineral additives. It is primarily used to make concrete.



Cement Definitions

- CARB MRR/Cap-and-Trade definitions
  - “Cement” means a building material that is produced by heating mixtures of limestone and other minerals or additives at high temperatures in a rotary kiln to form clinker, followed by cooling and grinding with blended additives. Finished cement is a powder used with water, sand and gravel to make concrete and mortar. (MRR and C&T Regulation)
- Most common types of cement is called Portland cement, or ordinary Portland Cement (OPC).

Portland Cement (ASTM C150)

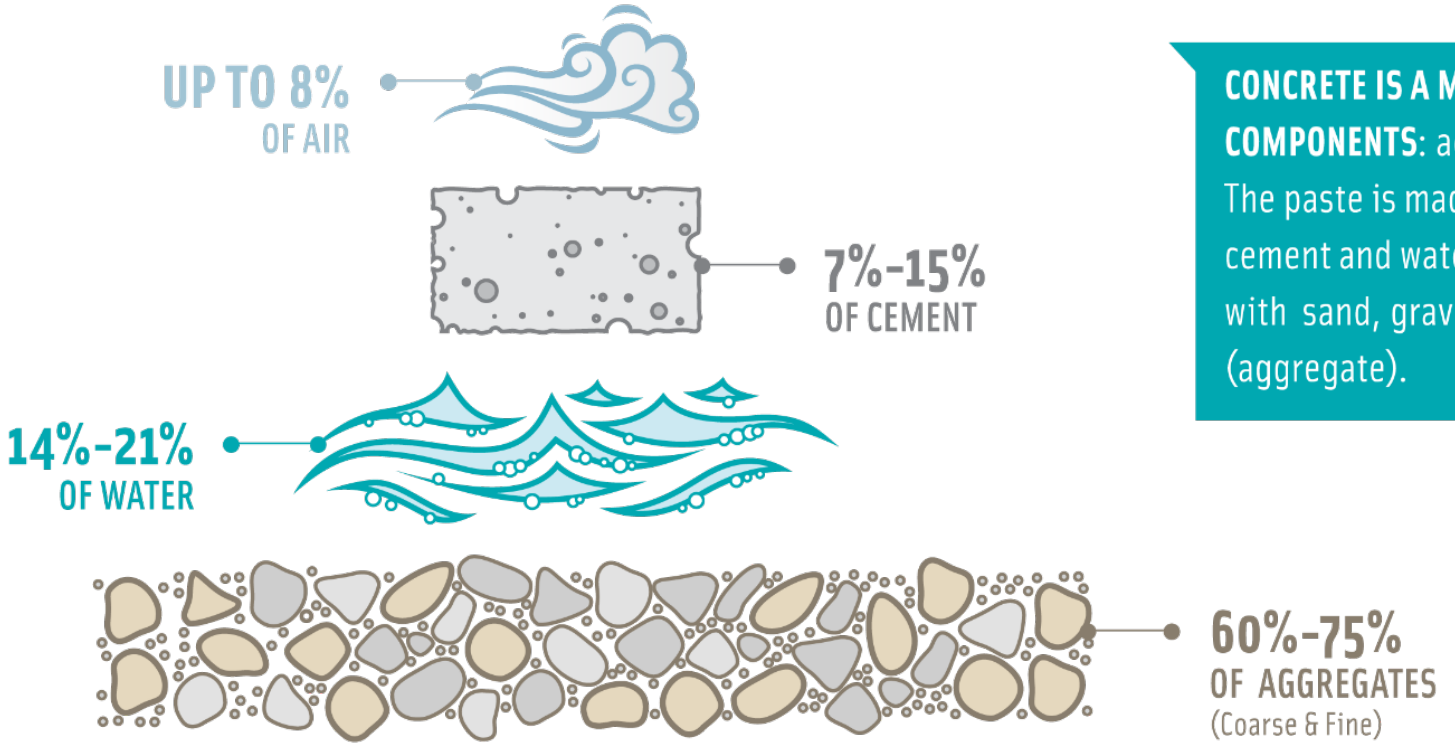
Cement Type	Description
Type I	Normal
Type II	Moderate Sulfate Resistance
Type II (MH)	Moderate Heat of Hydration (and Moderate Sulfate Resistance)
Type III	High Early Strength
Type IV	Low Heat Hydration
Type V	High Sulfate Resistance

Blended Hydraulic Cement (ASTM C595)

Cement Type	Description
Type IL	Portland-Limestone Cement
Type IS	Portland-Slag Cement
Type IP	Portland-Pozzolan Cement
Type IT	Ternary Blended Cement

Concrete Definition

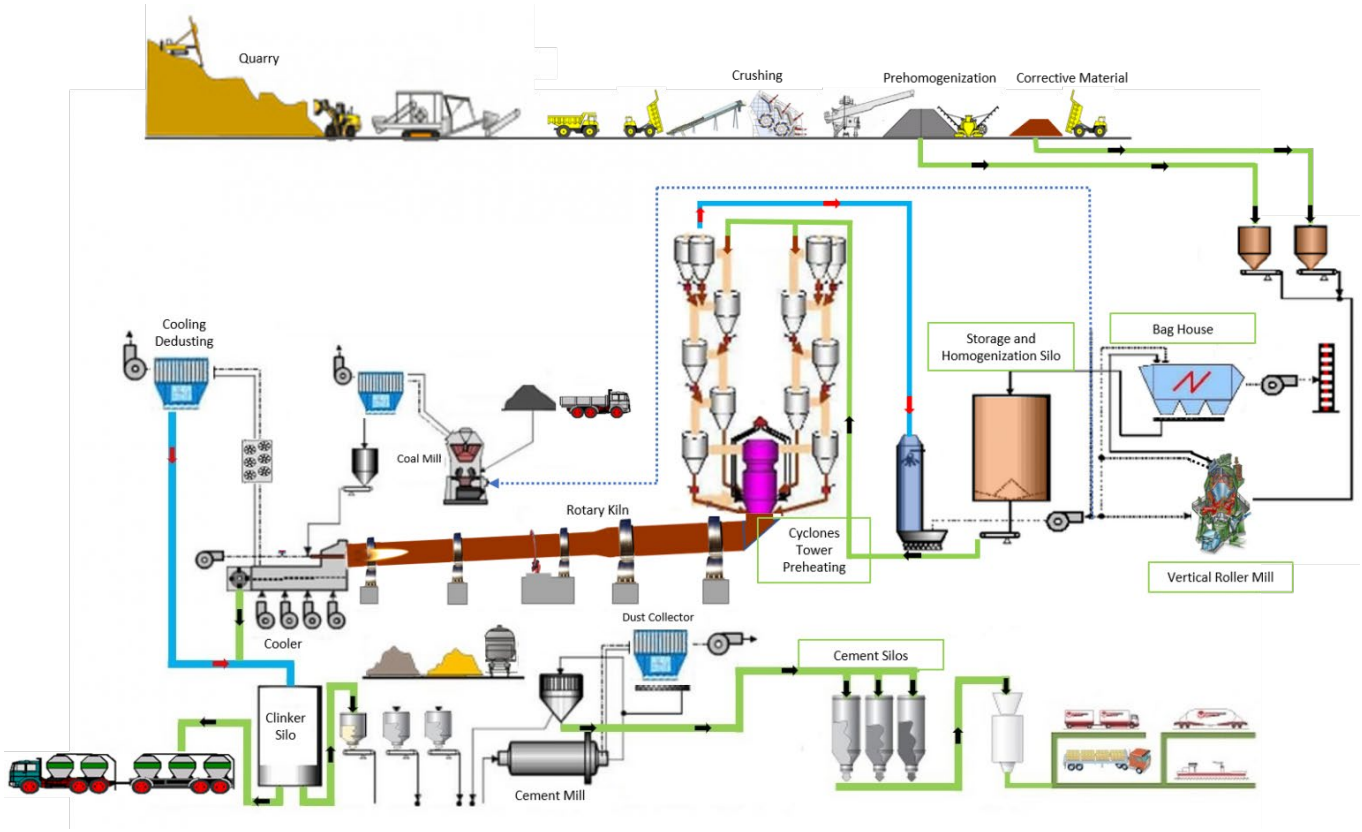
- Concrete is a stone-like construction material that consists of cement, water, aggregate (gravel and sand), and air. Cement binds and hardens concrete.



CONCRETE IS A MIXTURE OF TWO COMPONENTS: aggregate and paste. The paste is made up of portland cement and water, which then binds with sand, gravel or crushed stone (aggregate).

Source: Portland Cement Association

How is Portland Cement Made?



Source: The Cement Institute https://thecementinstitute.com/an-introduction-to-portland-cement-manufacturing/

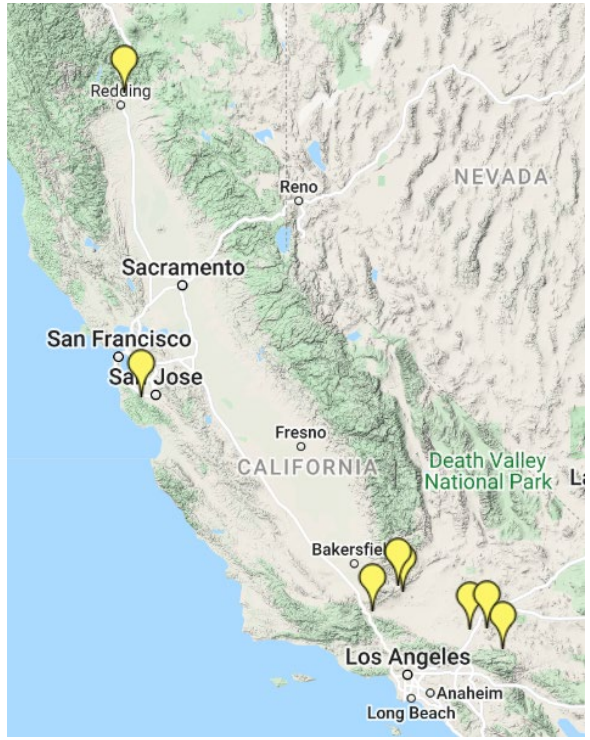
1. Limestone, clay are other minerals are mined (or imported) and ground
2. Feedstock is introduced to rotary kilns for calcination to make clinker

   $CaCO_3$ + heat (~1500 °C) → CaO + CO_2
3. Clinker is cooled, ground, and blended with ~5% of gypsum, ~5% limestone, and small amount of supplementary cementitious materials (SCMs) to be shipped to customers that include concrete batch plants, retailers, contractors, and large end-users

Portland Cement Plants in California

- In 2019, the 8 cement plants operating in California produced about 10.1 MMT of cement and emitted 7.94 MMTCO2e

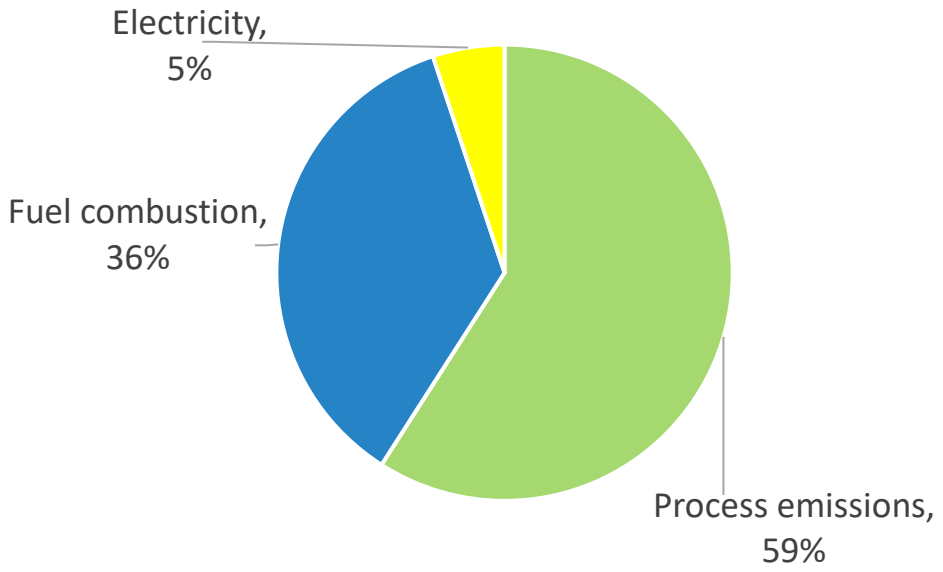
Facility	AQMD	GHG Emissions (2019, MT CO_2e)
Cemex Construction Materials Pacific LLC – Victorville	Mojave Desert AQMD	2,018,068
CalPortland Company - Oro Grande	Mojave Desert AQMD	1,250,872
CalPortland Company - Mojave	Eastern Kern APCD	1,124,363
Mitsubishi Cement - Lucerne Valley	Mojave Desert AQMD	1,112,357
National Cement Company - Lebec	Eastern Kern APCD	812,346
Lehigh Southwest Cement Co. - Cupertino	Bay Area AQMD	768,367
Lehigh Southwest Cement Co. - Tehachapi	Eastern Kern APCD	559,896
Lehigh Southwest Cement Co. - Redding	Shasta County AQMD	292,845



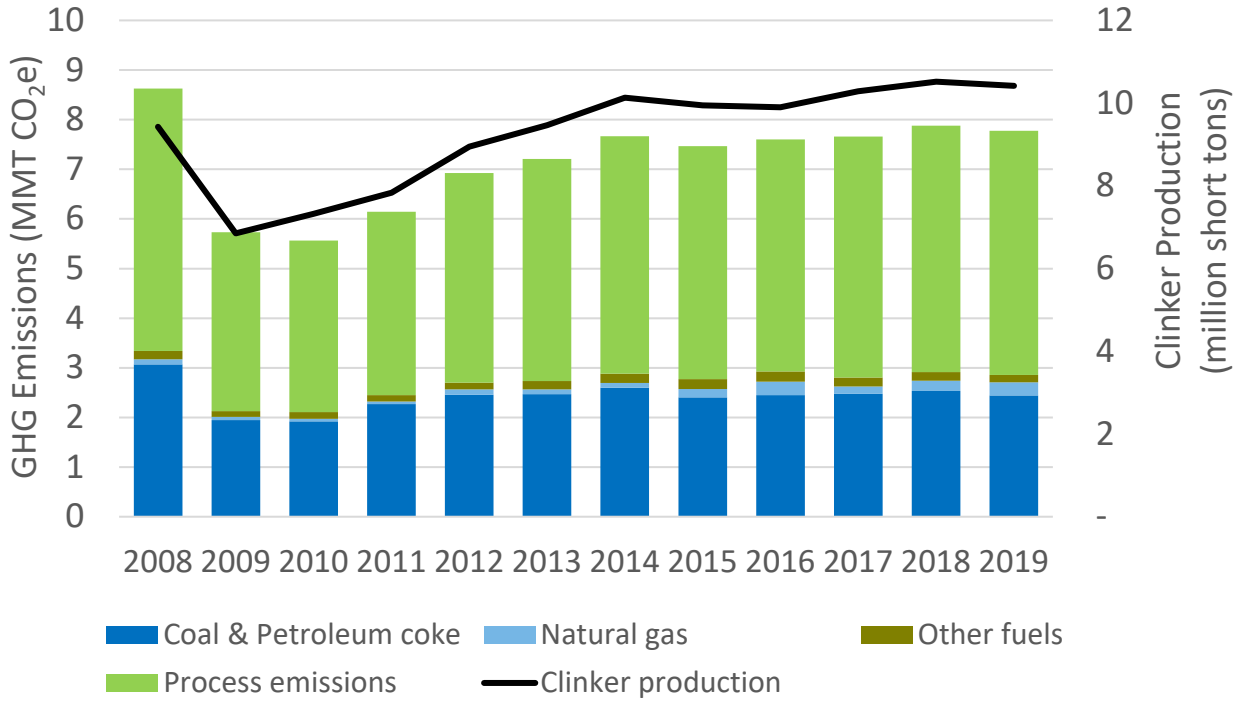
California Cement Sector GHG Emissions

Direct & Indirect Emissions

2008-19 annual average: 7.5 MMT



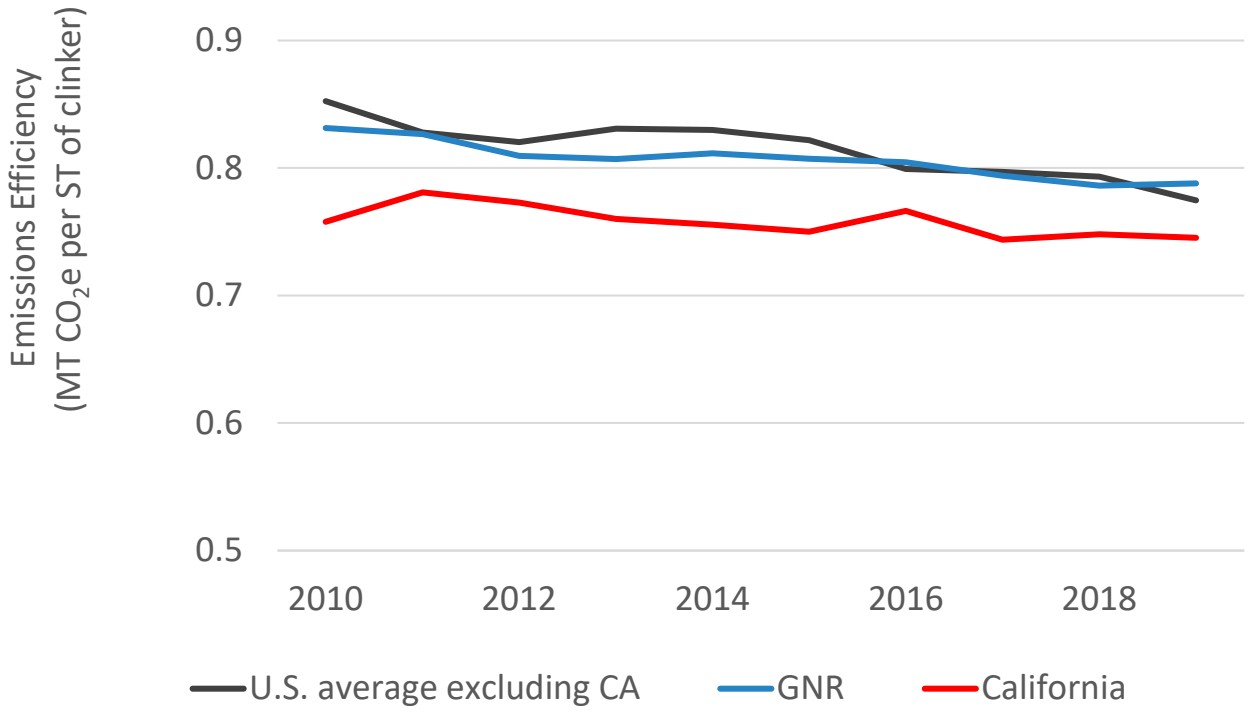
Direct Emissions by Source



Source: CARB Mandatory Reporting Regulation

California Cement Sector GHG Intensity

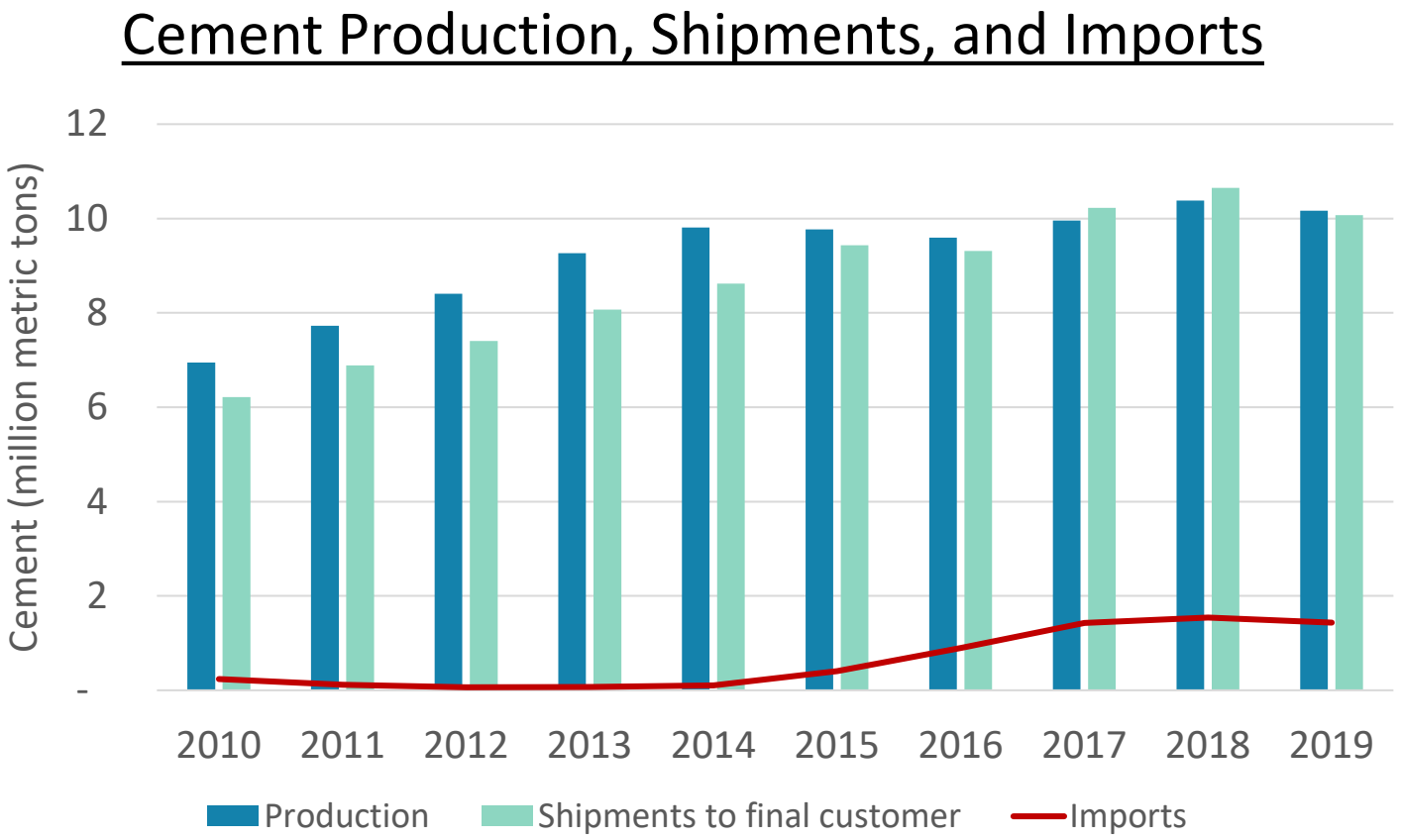
Clinker Production Emissions Efficiency



Data Sources

- **United States average excluding California:**
  - GHG Emissions: US EPA GHG Reporting Program
  - Production: USGS Minerals Yearbook
- **"Getting the Numbers Right" (GNR) Project,** which covers about 73% of cement plants in the US:
  - GHG emissions and production: the GNR project by the Global Cement and Concrete Association
- **California:**
  - GHG emissions and production: CARB Mandatory Reporting Regulation

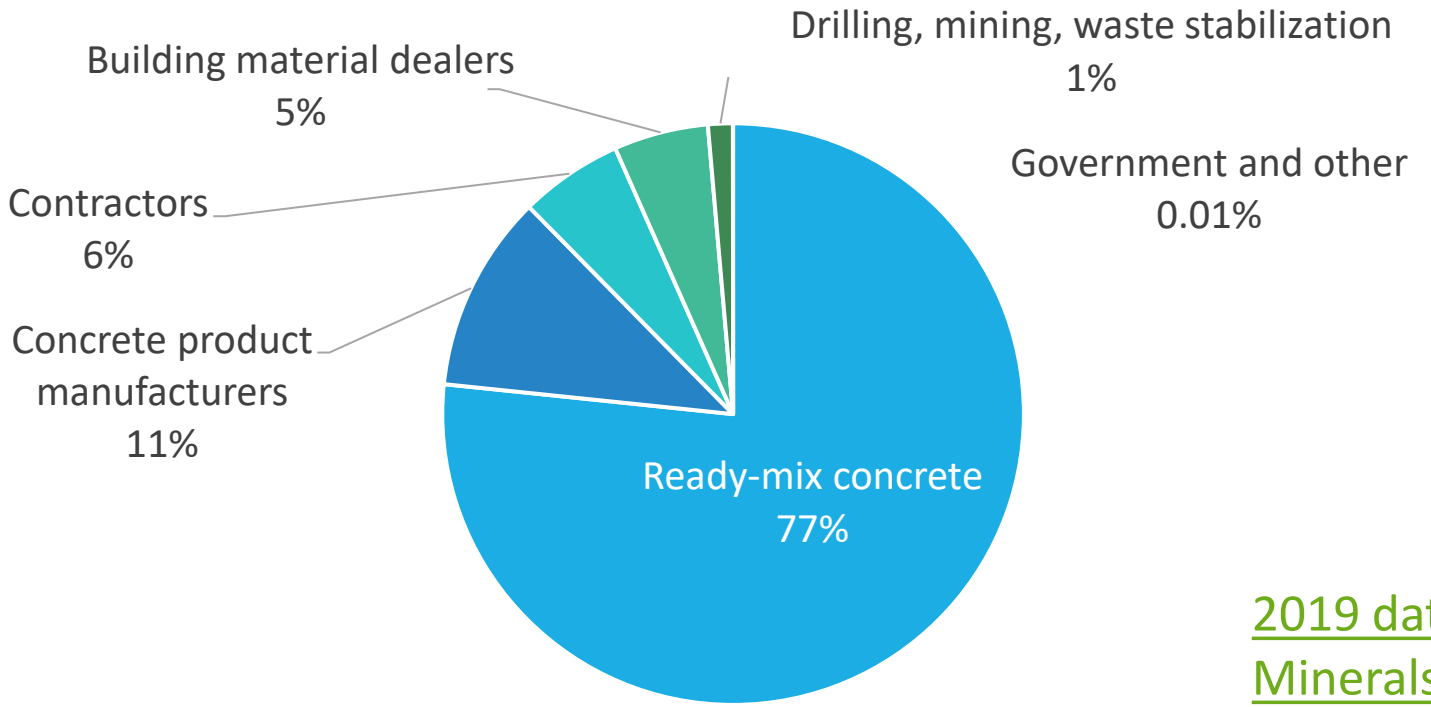
Cement Shipments and Imports



- Production and shipments of Portland cement in California
  - USGS Minerals Yearbook
- Imports: Imports for consumption to California ports in "first unit of quantity"
  - International Trade Commission dataweb

Cement Use by Type of Customer

Portland Cement Shipment by Type of Customer



2019 data from USGS Minerals Yearbook

Potential Opportunities to Reduce Cement GHG Intensity

Strategy Development Context

- What is "'cement' used within the state?"
  - How to define "cement" and the final point of blending to make it?
  - "Cement used within the state": Cement produced in CA - Cement produced and exported + cement imported to CA
- What is the scope of "GHG intensity?"
  - Scope 1 = direct emissions; Scope 2 = Scope 1 + indirect emissions
- What is "net-zero ?"
  - AB 1279 defines net-zero as "emissions of GHGs to the atmosphere that are balanced by removals of GHG emissions over a period of time as determined by CARB."
  - Carbon sinks available for the cement sector, and methods to quantify them

Opportunities to Reduce GHG Intensity at Existing/New Cement Plants (1 of 2)

- **Pathway 1:** Manufacture Portland cement and reduce/eliminate the associated emissions
  - Process emissions
    - Carbon capture and sequestration
  - Combustion emissions
    - Improve energy efficiency and heat recovery
    - Switch fuel to low-carbon fuels such as hydrogen, biomethane, biomass, or waste-derived fuels
    - Electrification

Opportunities to Reduce GHG Intensity at Existing/New Cement Plants (2 of 2)

- **Pathway 2:** Manufacture alternative/novel cement
  - Replace clinker with zero-to-low emission alternatives
    - Portland limestone cement (PLC)
    - SCMs
    - Mineral fillers
    - Alternative clinker
    - Alkali-activated materials

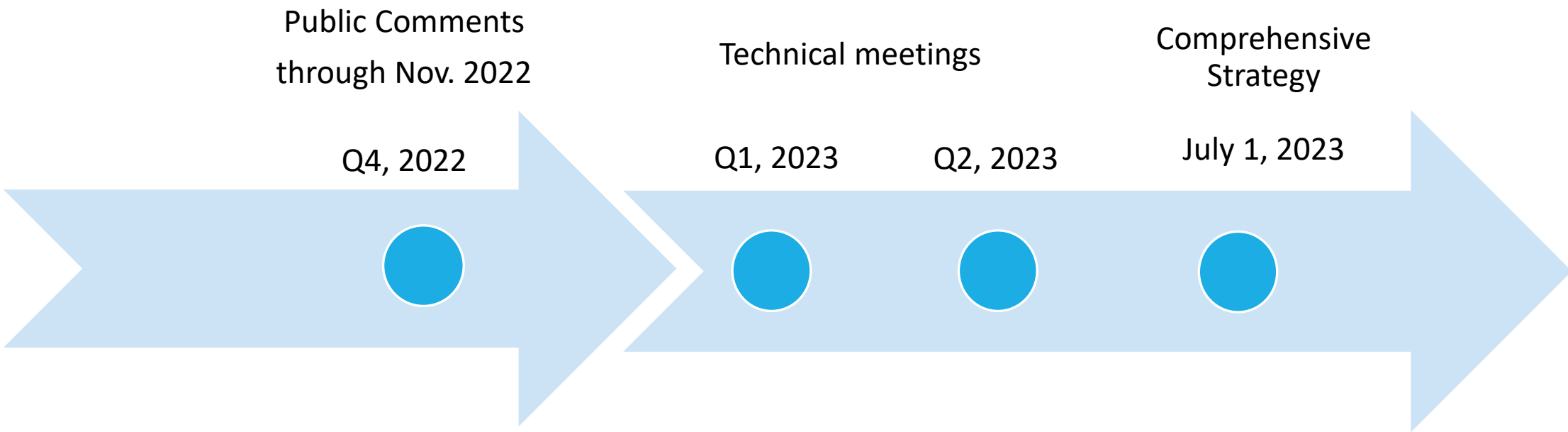
Opportunities to Reduce GHG Intensity Outside of Existing Cement Plants

- Electricity source
  - Electricity from renewable sources
- Other strategies
  - Encourage market acceptance of low-GHG cements, including PLC
  - Explore financial incentives for new technologies
  - Support research, development, and deployment for innovation
- SB 596 prohibits “offsets” outside the cement sector
  - Section 38561.2(a)(3). GHG intensity of cement shall ***not*** include GHG emissions reductions attributable to activities or “offsets” that are unrelated to the raw materials, fuels or other energy sources, processes, or transportation involved in making or using cement or its inputs

CARB Contract with UC Davis Researchers

- CARB has a contract with a research team at UC Davis to inform the SB 596 process
  - For certain technical measures that could help meet the goals of SB 596, the UC Davis research team will (1) identify and assess barriers to implementing the measures, and (2) identify an initial suite of California-specific measures and actions to overcome barriers
    - Fuel-switching for cement kiln direct combustion and electricity generation;
    - Carbon capture and storage (CCS) at cement plants;
    - Increased use of supplementary cementitious materials (SCMs);
    - Increased use of Portland limestone cement and other blended cements;
    - Use of alternative clinkers;
    - Use of alkali-activated materials (AAMs); and
    - Energy efficiency and waste heat recovery at cement plants

Next Steps



- Written comments can be submitted following the workshop: https://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=SB596-wkshp-Oct20-ws&comm_period=1
- Comment closing date: November 30 (5:00PM)