

Cement Sector Net-Zero Emissions Strategy Workshop: Identifying Barriers



MAY 31, 2023

Agenda (1 of 2)

- Recap of SB 596
 - SB 596 requirements and summary of public comments
 - Defining “Cement”
 - Potential methods to calculate GHG emissions intensity
- Identifying barriers
 - Cement-concrete value chain
 - Rules that govern cement production and concrete use
 - Barriers associated with implementing GHG emission reduction options
 - SB 596 community engagement
 - Funding opportunities for decarbonization technologies/projects

Agenda (2 of 2)

- Panelist presentations and discussion
 - Larry Sutter, Sutter Engineering
 - Jacquelyn Wong and Joe Harline, California Department of Transportation
 - Brian Reyes, Marin County Community Development Agency
 - Charles Rea, California Construction and Industrial Materials Association
 - Walter Kanzler, University of California San Diego, Resource Management & Planning

Public Participation

- Questions and Feedback
 - Use the “Q&A” box in the Zoom toolbar to write your question
 - If you cannot use the “Q&A” box, you may use the “**Raise Hand**” function in the Zoom toolbar
 - When staff call your name, please “**Unmute**” yourself by clicking the red button, and proceed to introduce yourself
 - If you have technical difficulties, please email: blayne.morgan@arb.ca.gov

SB 596 Recap

SB 596 Summary and Timeline

- **Summer 2023:** Develop a comprehensive strategy to achieve net-zero emissions for cement used within California by 2045
- **2028:** Assess the feasibility of achieving the interim targets
- **2035:** Interim targets (40% below the 2019 average GHG intensity)
- **2045:** Net-zero emissions for cement use in California

- Staff is working to develop a comprehensive strategy
 - Feedback and comments will be considered
 - Research contract with UC Davis is nearing completion

Summary of Public Comments

- Comments submitted
 - Support for the goals of SB 596 and consideration of a wide range of GHG reduction options
 - Technologies to achieve drastic emissions reductions are emerging
 - Barriers to implement new technologies include high capital costs, lack of support for RD&D, insufficient value chain-wide coordination and complex permitting process
 - Emissions leakage concerns
 - Current impacts on neighboring communities, public health, and environment from fuel combustion at cement plants and concerns associated with carbon capture, transportation and sequestration and alternate fuels
 - Suggestions for potential policy options to accelerate emissions reductions

Definition of “Cement” (1)

- Current definition of the Cap-and-Trade Program and Mandatory Reporting Regulation:
“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.”

Definition of “Cement” (2)

- Should CARB consider a more flexible definition, such as a performance-based definition, to accommodate emerging materials and technologies that do not involve calcination of limestone to make cement/cementitious materials?
 - Potential definition: cement that satisfies requirements of ASTM C150, C595 or C1157
- Should “supplementary cementitious materials” be part of “cement?”
If so, where should the final stage of cement production be?
 - CARB’s Mandatory Reporting Regulation (MRR) collects data from cement plants, where some SCMs are blended
 - More SCMs are blended at downstream processors but no reporting system is in place

GHG Emissions Intensity Metric for a Baseline

- SB 596 requirements
 - Define a metric for GHG intensity for cement used within California and develop a baseline using 2019 data
- Potential metric: GHG emissions divided by production
 - Emissions should include on-site emissions and indirect emissions associated with electricity
 - Emissions could potentially include domestic production and imports (exclude exports)
 - Data exist to estimate GHG emissions associated with imports
 - Quantity of cement imports: U.S. Census
 - Global Cement and Concrete Association's (GCCA) Getting the Numbers Right (GNR) project
 - Should CARB try to collect information on SCMs blended at downstream processors in 2019?

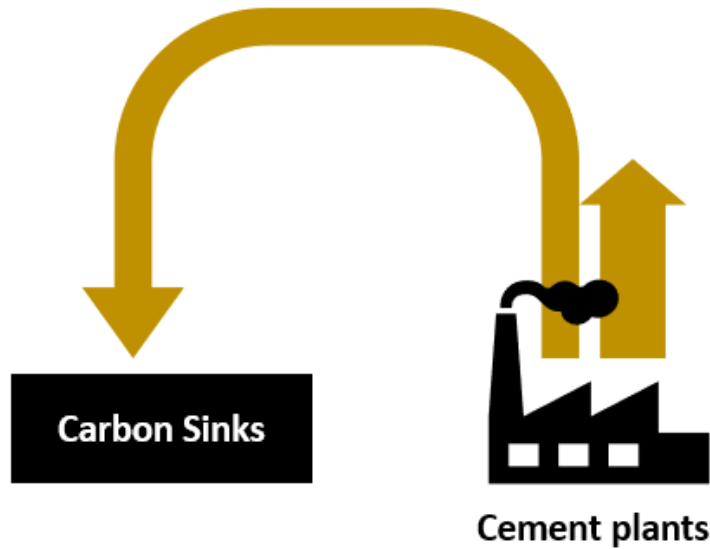
Identifying Barriers

SB 596 - Barriers to Deployment

- “A wide range of commercially available technologies and practices exist to reduce and remove emissions of GHGs throughout the life cycle of cement and concrete production and use, and these technologies and practices face a series of market and regulatory barriers hindering their deployment.”
- “Assess the effectiveness of....measures....to overcome the market, statutory, and regulatory barriers inhibiting achievement...”

Two Paths for GHG Emissions Reductions

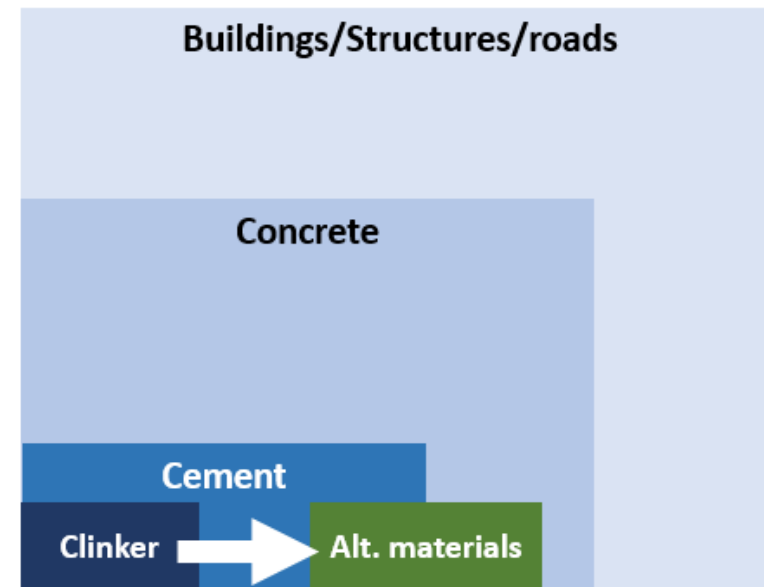
Emissions reduction management



Carbon capture, use and sequestration

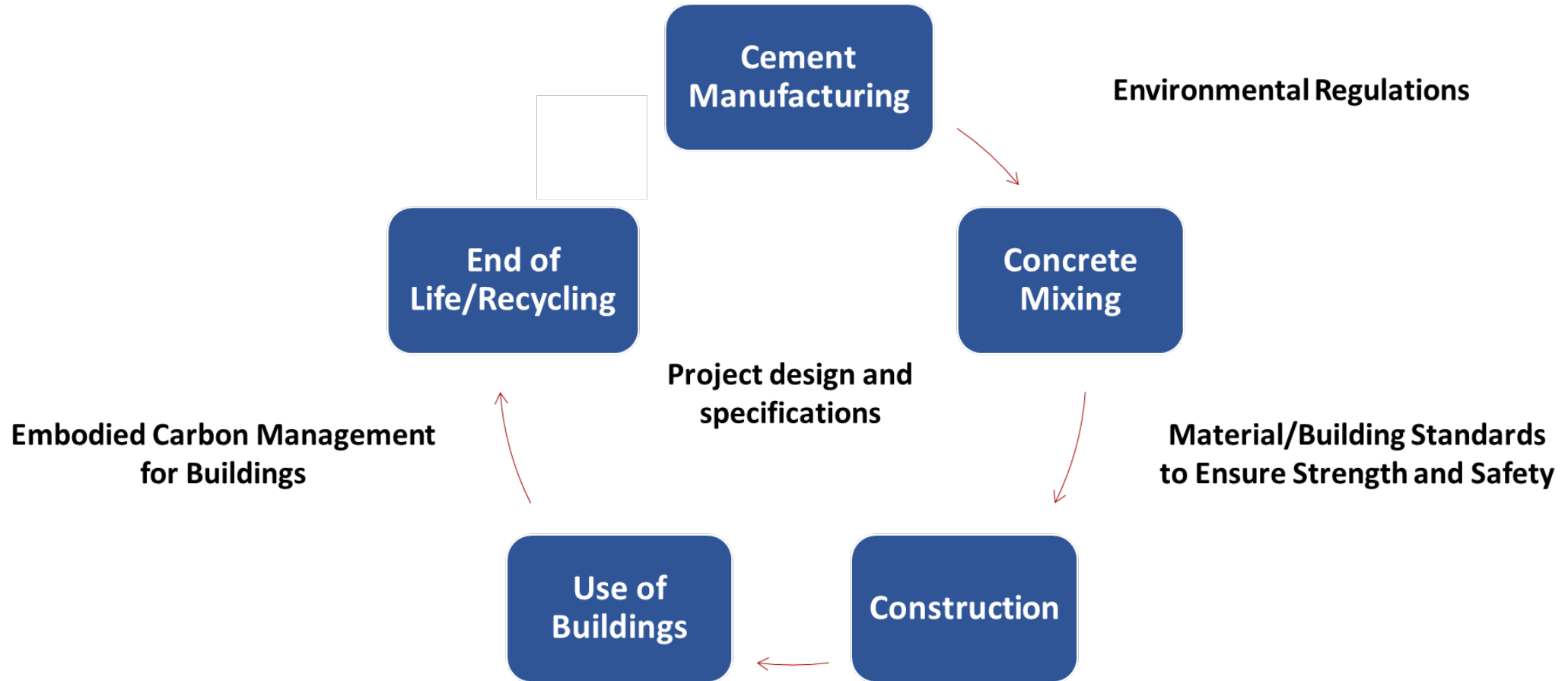
Reduce emissions from clinker production

Product change management



Reduce clinker intensity by reducing clinker used in cement, cement used in concrete, concrete used in buildings

Rules Governing the Cement-Concrete Value Chain



Potential Emissions Reduction Options Associated with Clinker Production

- Process emissions
 - Hard to abate, but CO₂ stream is concentrated
 - Carbon capture, use and sequestration
- Combustion emissions
 - Carbon capture, use and sequestration
 - Fuel-switching
 - Short/mid-term – biomass, waste-derived fuels
 - Long-term low- or zero-carbon hydrogen and biomethane
 - Improve energy efficiency and recover waste heat
 - Electrification
 - Heat batteries

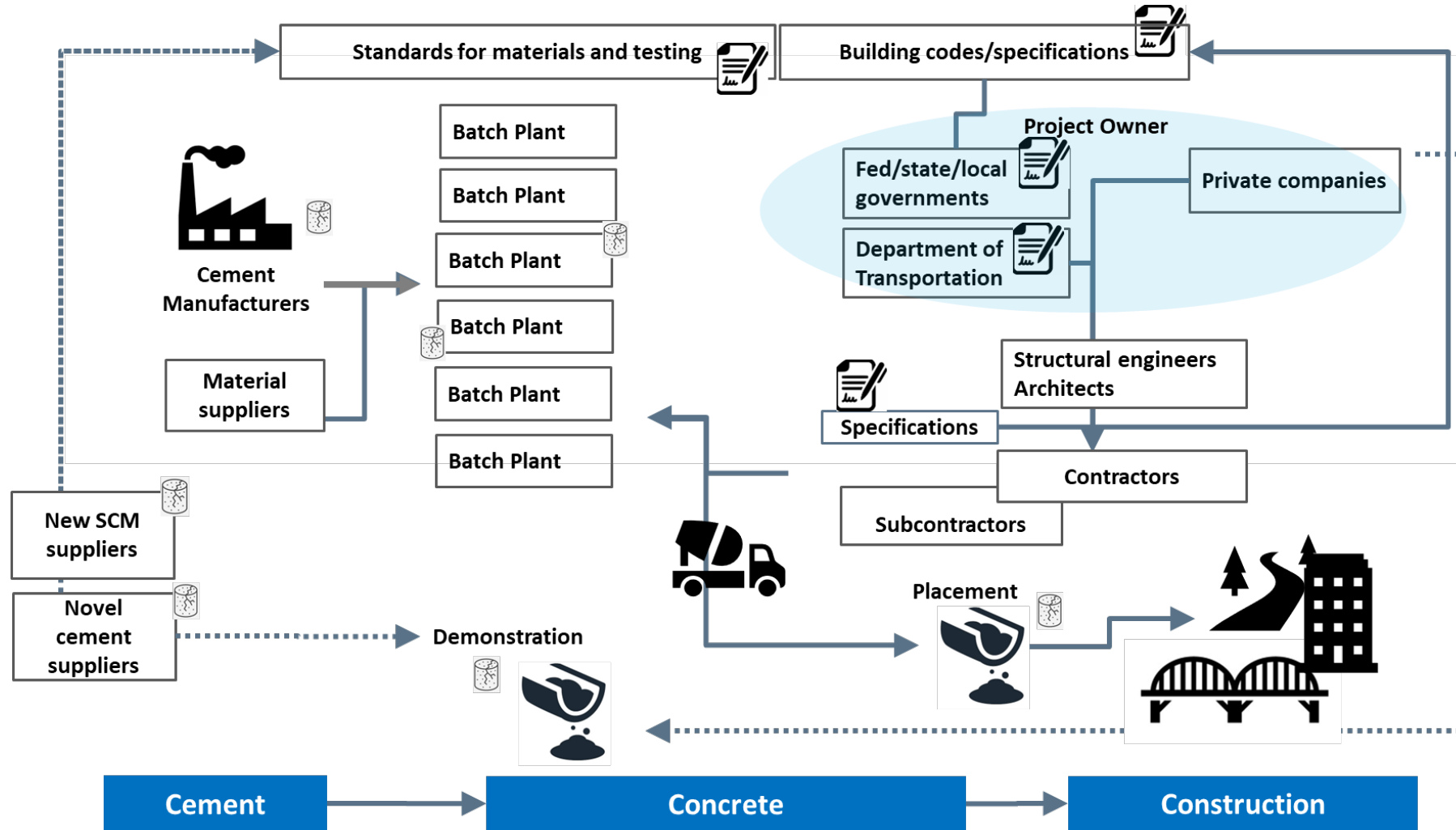
Barriers for Emissions Reductions Options Associated with Clinker Production

- Carbon capture, use, and sequestration (CCUS)
 - Installation of CCUS units: capital costs, land and water use, additional energy requirements, air emissions
 - Transportation and sequestration: high capital costs, siting, environmental and public health concerns
- Fuel-switching and electricity use
 - Mid/Long-term: Hydrogen or biomethane
 - Short/mid-term: bio- or waste-derived fuels face supply and air pollution concerns
 - Electricity: rates and incentives
- Every new project requires permitting consideration
 - New projects and major changes require multiple permits
 - SB 905 implementation process will inform the implementation of CCS projects

Potential Clinker Intensity Reduction Options

- Reduce clinker-to-cement/concrete ratio
 - Use of Portland limestone cement (PLC)
 - Use of conventional supplementary cementitious materials (SCMs)
 - Use of emerging SCMs - calcined clay, glass pozzolans, other
 - Increase binder efficiency, efficient use of admixtures
- Replace limestone with other materials to make clinker to avoid process emissions
 - Carbonatable calcium silicate
 - Geopolymers/alkali-activated materials
 - Magnesium oxides derived from magnesium silicates
 - Bio-concrete
- Design changes to reduce the amount of concrete used

Barriers to Clinker Intensity Reductions (1): Complex Concrete Value Chain



Barriers to Clinker Intensity Reductions (2)

- Change in products requires design changes at all levels
 - Product mix, storage, testing
 - Specification/material standards, building codes
 - Building design
- Design changes are associated with risks (real and perceived)
 - Changes cannot compromise buildings/structure strength and safety
 - Financial risks and construction schedule

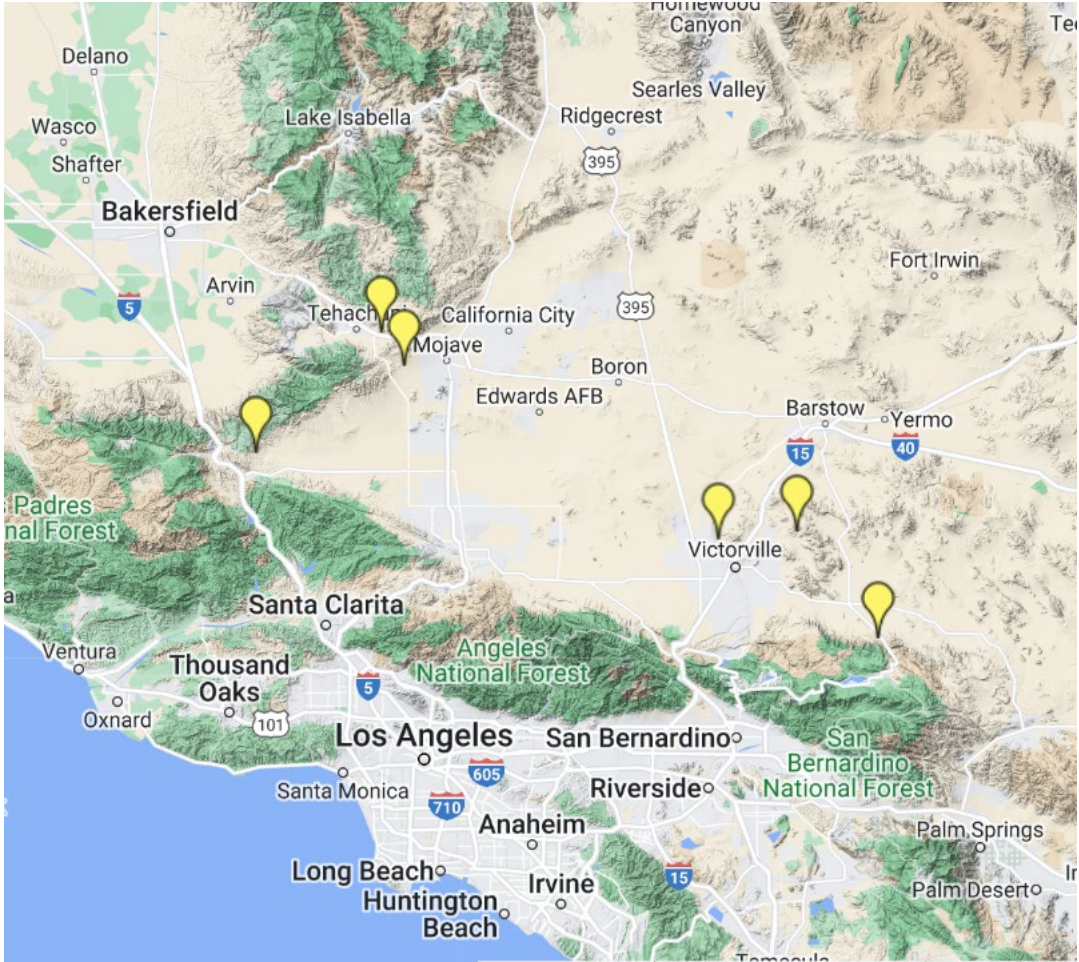
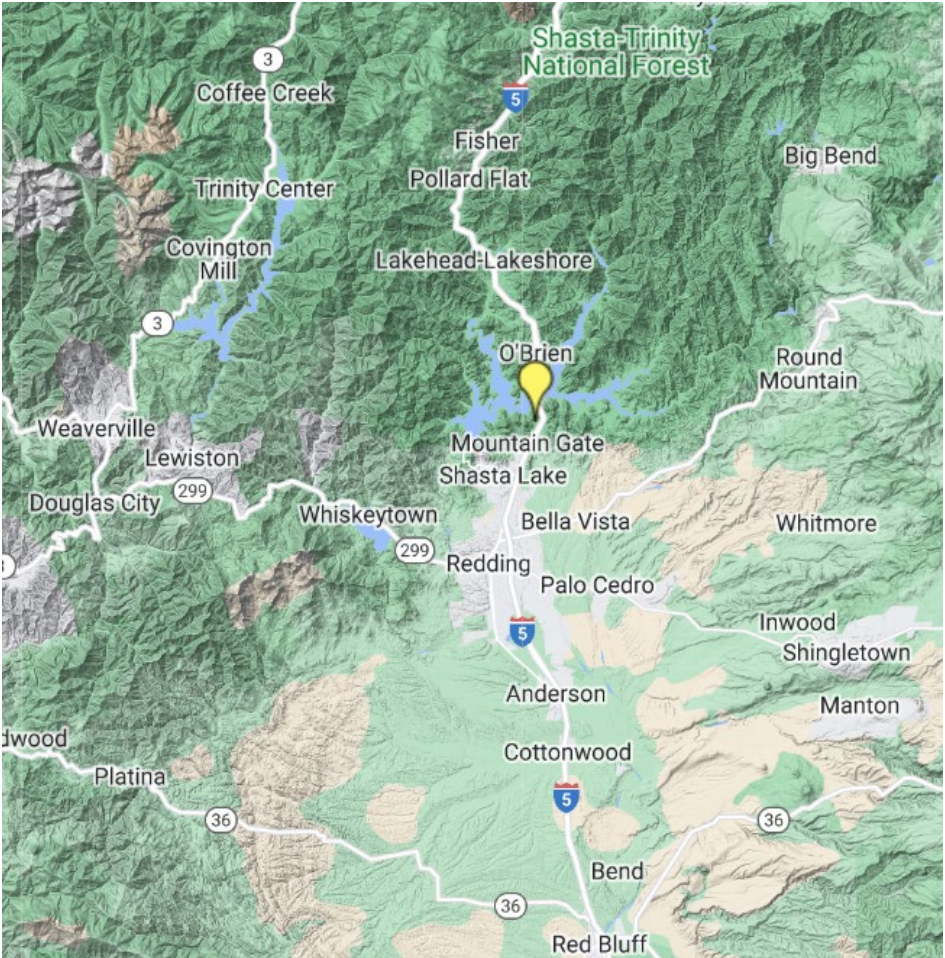
Unlocking Barriers

- Coordination and collaboration is needed throughout the cement-concrete value chain
 - Share experiences and knowledge to increase collective readiness to deploy low carbon products/solutions
- Achieve economies of scale through more widespread adoption of new products and practices
- Update material standards/building codes to enable low carbon cement/concrete
- Implement robust and comparable emissions reductions quantification methods
 - SB 596 is focused on emissions from cement use, but achieving net-zero emissions requires efforts across the value chain

Community Engagement

- SB 596: “Identify actions that reduce adverse air quality impacts and support economic and workforce development in communities neighboring cement plants”
- Cement plants
 - Three plants in Mojave Desert AQMD
 - Three in Eastern Kern APCD
 - One in Shasta County AQMD
- CARB staff is in the process of engaging with local communities near cement plants

Locations of the California Cement Plants



Funding Opportunities to Support Cement Decarbonization

- Federal Opportunities

Opportunity	Statute	Available Funding	Deadline
Regional Clean Hydrogen Hubs (H2Hubs)	IIJA	\$7,000,000,000	4/7/2023
Industrial Demonstrations Program	IIJA,IRA	\$6,000,000,000	8/4/2023
Climate Pollution Reduction Grants	IRA	\$5,000,000,000	4/28/2023
Regional Direct Air Capture Hubs	IIJA	\$3,500,000,000	3/13/2023
Carbon Storage Validation and Testing	IIJA	\$2,250,000,000	11/30/2022
Carbon Capture Demonstration Projects	IIJA	\$1,700,000,000	5/23/2023
Carbon Capture Large-Scale Pilot Projects	IIJA	\$820,000,000	6/21/2023
Clean Hydrogen Electrolysis, Manufacturing, and Recycling	IIJA	\$750,000,000	7/19/2023
Port Infrastructure Development Program (PIDP)	IIJA	\$662,203,512	4/28/2023
Advanced Energy Manufacturing and Recycling Grants	IIJA	\$350,000,000	6/8/2023
IEDO FY23 Multi-topic FOA	Energy Act of 2020	\$156,000,000	6/23/2023
Industrial Efficiency and Decarbonization FOA		\$104,000,000	1/11/2023
Direct Air Capture Commercial Prize	IIJA	\$100,000,000	10/16/2024

- State Opportunities

- [Industrial Decarbonization and Improvements to Grid Operations Program administered by CEC](#)

- What role can CARB play, such as publicizing funding opportunities?

Panelist Presentations

Case Studies: Portland Limestone Cement

- Focus on PLC and SCMs
 - The industry already has experience
 - Near-term deployment potential
- Decision-makers associated with the selection of concrete products
 - Project owners (public/private, horizontal/vertical)
 - Architects/engineers/contractors
 - Concrete mix suppliers, precast/pipe/masonry concrete producers
 - Governing bodies: regulatory agencies and standard/code setters
- Discussion goals:
 - Learn from panelists' actions and perspectives to identify actionable items for coordination to increase collective readiness to deploy the use low-carbon cement/concrete

Panel Presentations

1. Larry Sutter: Low-carbon concrete implementation and the role of field demonstrations
2. Jacquelyn Wong and Joe Harline, California Department of Transportation: Portland Limestone Cement: Lessons Learned and Ongoing Efforts to Support Net-Zero Emissions
3. Brian Reyes; Marin County: Marin County Low Carbon Concrete Code Adoption and Implementation Learned Lessons
4. Charley Rea, CalCIMA: Concrete: Carbon impacts and opportunities
5. Walter Kanzler, UC San Diego: UC San Diego's perspective on using low-carbon cement

Public Comments

- Public Comments will be accepted through June 30, 2023
- CARB staff seeks feedback on:
 - “Cement” and “net-zero” definitions
 - Metrics and methodologies to estimate GHG emissions intensity
 - Additional GHG reduction opportunities that should be considered
 - Additional barriers that should be evaluated
 - Recommendations on actions to address adverse air quality impacts and support economic and workforce development in local communities
 - Suggestions on actionable steps to increase collective readiness to deploy GHG reduction strategies based on today’s panel discussion
 - Other topics CARB should consider

Next Steps

