

An aerial photograph of a long, multi-lane concrete bridge stretching across a vast body of water. The bridge features a series of arches supporting its structure. Several cars are visible on the bridge, and a sailboat is in the water to the left. The water is a deep blue-green color, and the sky is filled with light, wispy clouds.

# ROADMAP TO CARBON NEUTRALITY

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Executive Summary

# EXECUTIVE SUMMARY

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PCA member companies are committed to achieving carbon neutrality across the value chain by 2050. The PCA Roadmap involves the entire value chain starting at the cement plant and extending through the entire life cycle of the built environment to incorporate the circular economy. This approach to carbon neutrality leverages relationships at each step of the value chain, demonstrating to the world that this industry can address climate change.

The cement and concrete industry cannot do this alone. To bring down CO<sub>2</sub> emissions from all sources, including the building sector, one must recognize the way that our world is interconnected. Stakeholders must work together to ensure that the building sector is creating a built environment that is actually sustainable – this is why PCA member companies are embarking on a journey to carbon neutrality as a full industry and inviting others across the value chain to join this effort. Government agencies, non-governmental organizations, and academic institutions all have a role and the industry looks forward to collaborating on this mission to achieve carbon neutrality across the value chain.

The five links in the value chain include the production of clinker, the manufacture and shipment of cement, the manufacture of concrete, the construction of the built environment, and the capture of carbon dioxide using concrete as a carbon sink.

Each link identifies specific targets, timelines, technologies, and policies to reach the goal of carbon neutrality. The approach in this Roadmap leverages each step of the value chain from the farthest upstream to the final reuse and recycling phase. PCA member companies can specifically work on actions to reduce emissions associated with the manufacturing of clinker and production of cement. Many PCA member companies also produce concrete products. Additionally, PCA member companies sell to concrete producers and can seek to effect change there as well. Cement and concrete manufacturers do not control every link in the value chain, but this Roadmap provides direction and incentives that spur action.

On the next page are the pathways for unlocking emissions reductions along the cement and concrete value chain, now and in the near future.



## PRODUCTION: AT THE CEMENT PLANT

<b>Replace raw materials with decarbonated materials</b>	Using decarbonated materials eliminates CO <sub>2</sub> emissions from processing traditional raw materials, like limestone.
<b>Use alternative fuels</b>	Replacing traditional fossil fuels with biomass and waste-derived fuels lowers greenhouse gas (GHG) emissions and keeps materials out of landfills.
<b>Continue efficiency improvements</b>	Increasing energy efficiency reduces the amount of CO <sub>2</sub> emitted for each ton of product.
<b>Implement carbon capture, utilization, and storage (CCUS) technology</b>	CCUS directly avoids a significant portion of cement manufacturing emissions.
<b>Promote new cement mixes</b>	Creating new cements using existing and even alternative materials reduces emissions from mining for new materials, while optimizing the amount of clinker used ensures emissions correspond to necessary production.
<b>Increase use of portland-limestone cement (PLC)</b>	As an existing lower-carbon blend, universal acceptance of PLC will reduce clinker consumption and decrease emissions.

## CONSTRUCTION: DESIGNING AND BUILDING

<b>Optimize concrete mixes</b>	Considering the specific needs of the construction project and using only the materials necessary, avoiding excess emissions.
<b>Use renewable fuels</b>	Switching to solar, wind and other renewable sources of energy directly reduces emissions from other energy sources.
<b>Increase the use of recycled materials</b>	Diverting these materials from landfills.
<b>Avoid overdesign and leverage construction technologies</b>	Designing for the specific needs of the construction project reduces unnecessary overproduction and emissions; incorporating just-in-time deliveries.
<b>Educate design and construction community</b>	Improve design and specifications to be more performance oriented which will permit innovation in cement and concrete manufacturing. Encourage the use of advanced technologies to improve structural performance, energy efficiency, resiliency, and carbon sequestration.

## EVERYDAY: CONCRETE INFRASTRUCTURE IN USE

<b>Incentivize energy efficient buildings</b>	Increasing buildings' energy efficiency can cut energy use and resulting emissions from heating and cooling.
<b>Reduce vehicle emissions by improving fuel efficiency</b>	Because of its rigidity, concrete pavements enhance the fuel efficiency of vehicles driving over them, reducing vehicle emissions.
<b>Decreased maintenance</b>	Due to their durability, concrete structures (buildings, pavements, bridges, dams, etc.) last longer and require less frequent maintenance.
<b>Recycling</b>	Concrete in place can be 100% recycled, limiting the use of raw materials and production emissions.
<b>Carbonation</b>	Every exposed concrete surface absorbs CO <sub>2</sub> and over the course of its service life, a building can reabsorb 10% of cement and concrete production emissions.

# SHARED ADVOCACY IS CRITICAL

The Roadmap to carbon neutrality is more than targets, timelines, and technologies for each link within the value chain. Each of these require significant policy support, including a market-based price on carbon. This Roadmap also provides ten major policy necessities that, together with market innovations, regulatory refinements, and funding requirements will stimulate, support, and sustain the cement and concrete industry as it becomes a leader in achieving carbon neutrality.

The industry encourages:

1. Accelerated research, funding, and investment in manufacturing, material innovation, and CCUS technologies and associated infrastructure.
2. Streamlined regulation, siting, and permitting practices for facility and infrastructure modernization.
3. Recognition and credit for industry reduction levers.
4. Community acceptance of coal combustion residuals (CCRs), alternative fuels, CCUS, and other technologies.
5. Consideration of a market-based carbon price – such as a cap-and-trade mechanism – consistent with core principles, including fairness, transparency, and innovation.
6. Market acceptance of low-carbon alternative cements and concrete.
7. Adoption of performance-based standards for building materials.
8. Consideration of the full product, material, and building life cycle in procurement standards and policy.
9. Investments in clean fuel, energy, transportation, and industrial infrastructure.
10. Leakage protections for domestic manufacturers competing against less regulated imports.

## Leading collaboration

PCA represents U.S. cement manufactures and on behalf of the industry has developed this Roadmap, which identifies the targets, timelines, technologies, and supporting policies needed to achieve and potentially accelerate the goal of achieving carbon neutrality by 2050 across the value chain. PCA is uniquely positioned to lead this effort in collaboration with the cement and concrete industry and other stakeholders and looks forward to expanding its network of alliances as this Roadmap evolves.