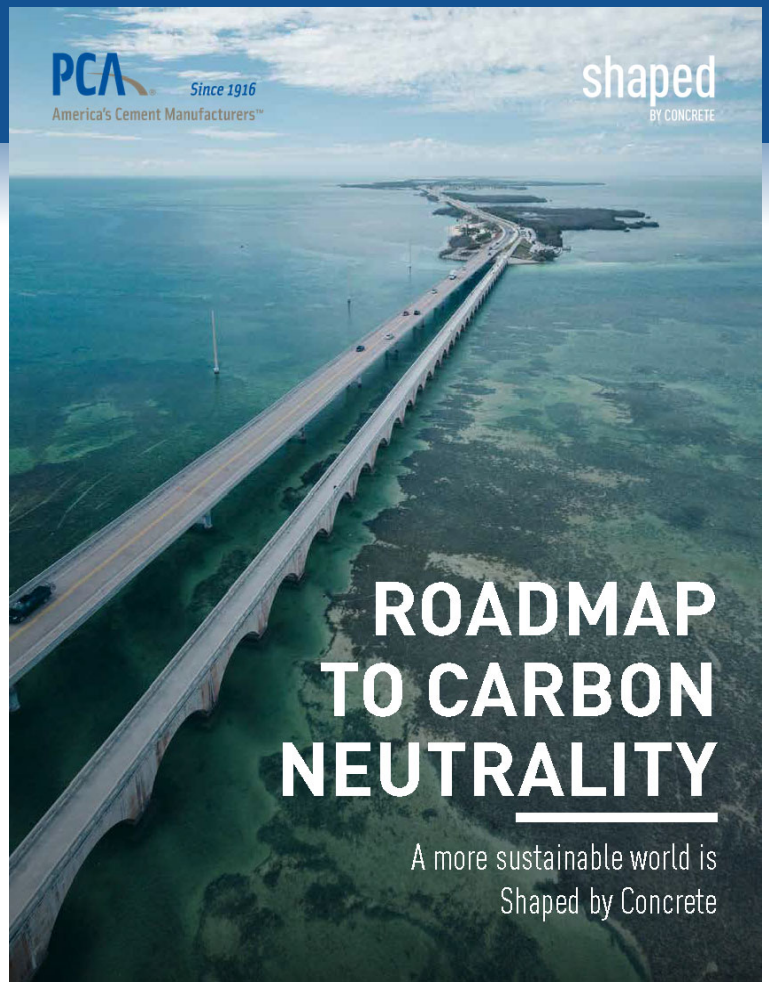
PCA's *Roadmap to Carbon Neutrality by 2050*

February 27, 2023 | Paul Tennis | Sr. Director, Research and Product Standards

SCIENCE: Steel and Cement Manufacturing Innovations to Enable A Low Carbon Economy



Available online at
www.cement.org

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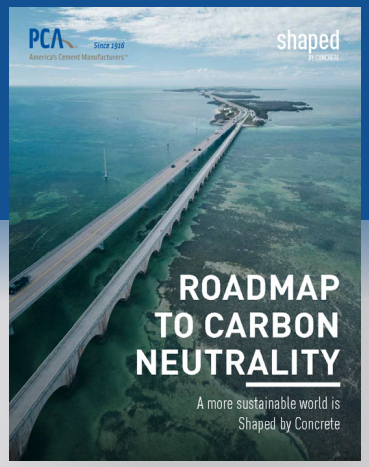
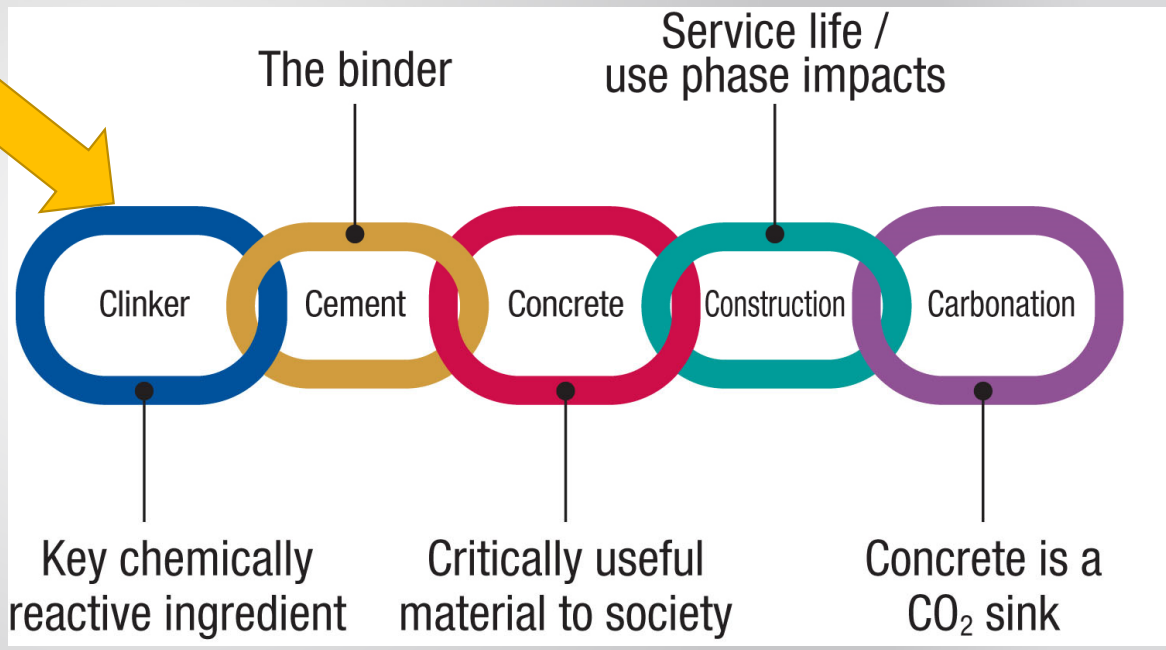


PCA'S ROADMAP TO CARBON NEUTRALITY

Primary Source of CO_2 Emissions



Everyone in the value chain has a role to play

Clinker and Cement – cement manufacturers

Concrete – ready mix producers, designers, specifiers

Construction – designers, specifiers, contractors

Carbonation – scientists, designers, contractors

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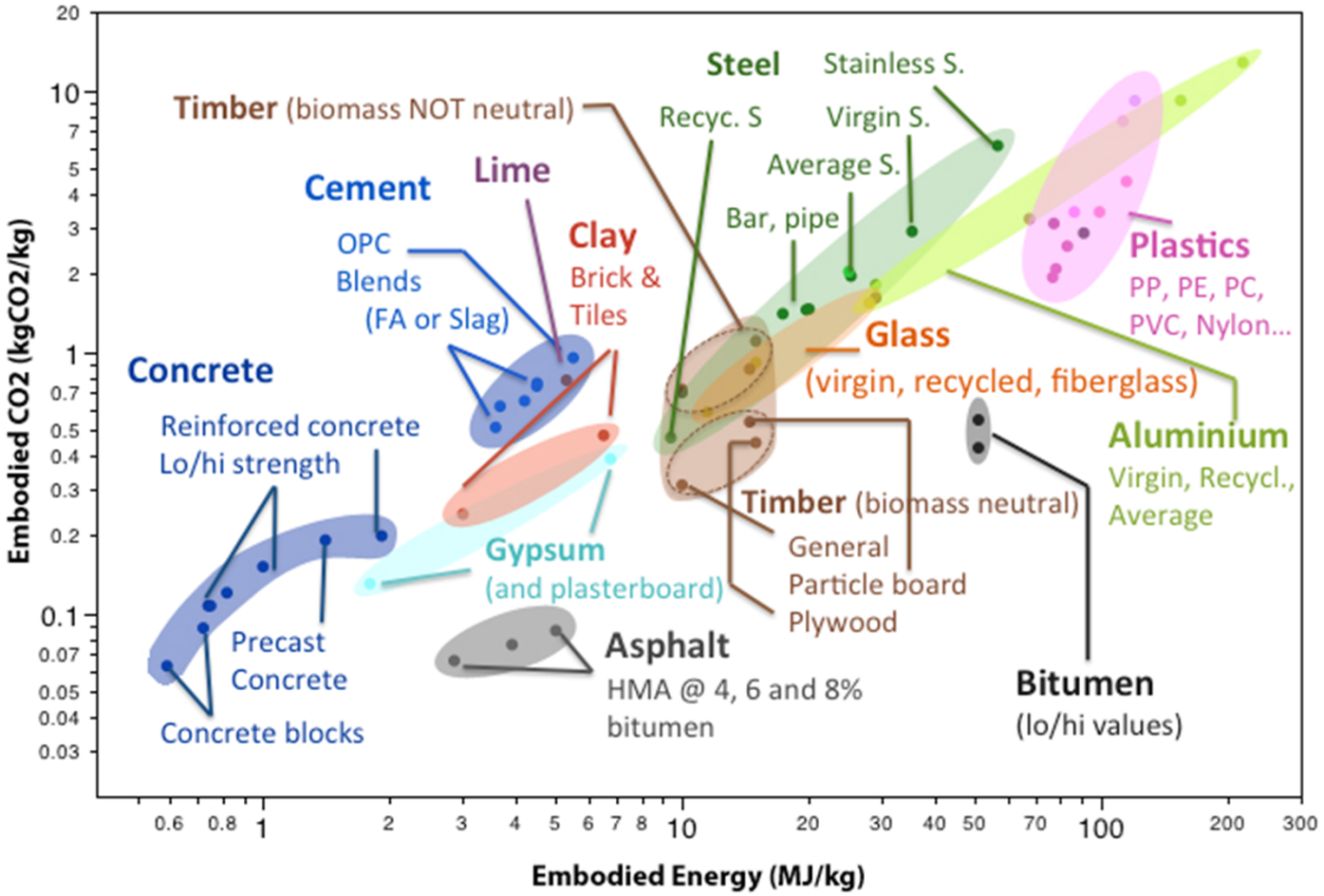
Concrete *is* Environmentally Friendly



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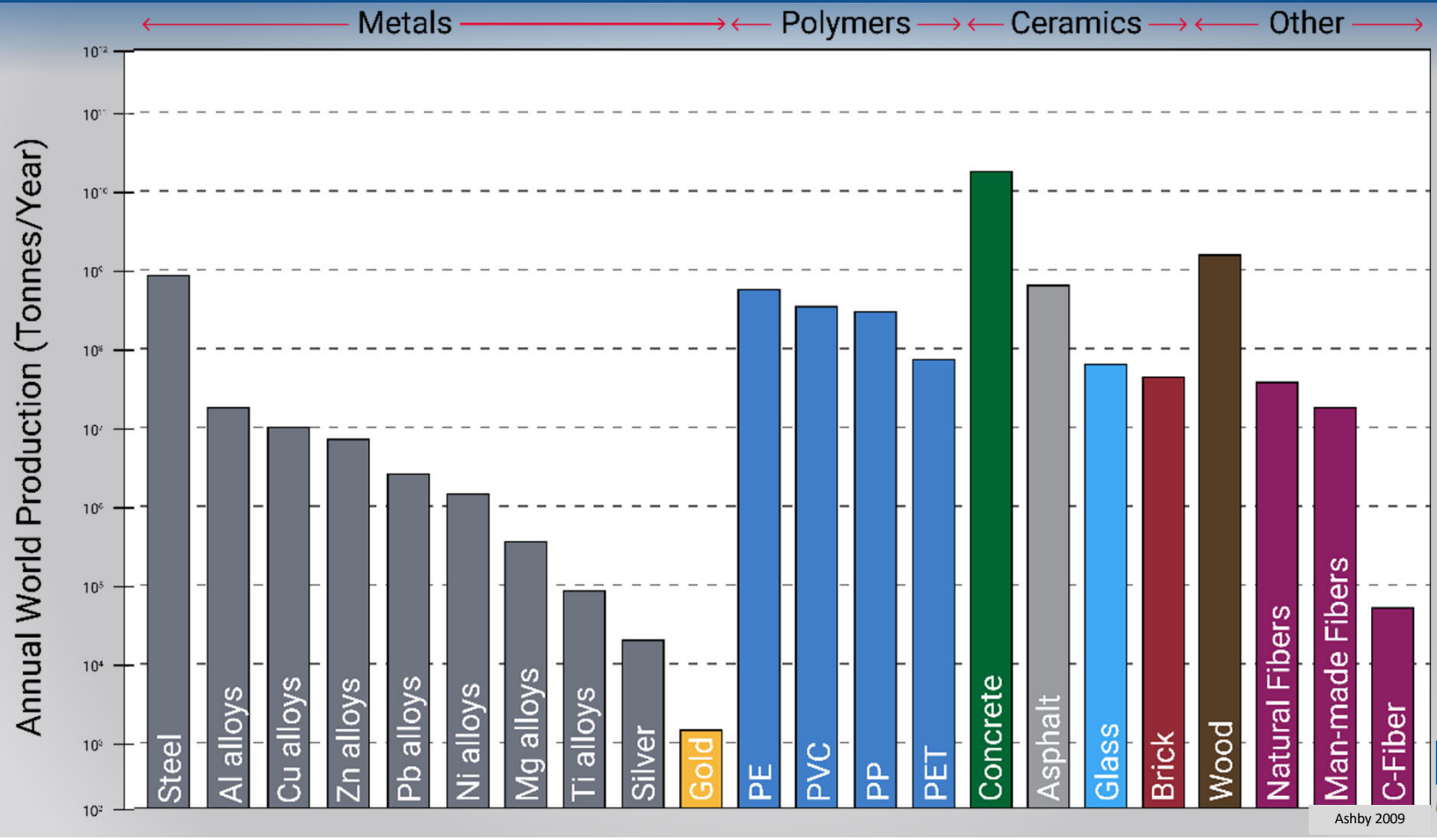
Barcelo, Kline, Walenta (2012)

Concrete is the most widely used construction material



Ashby 2009

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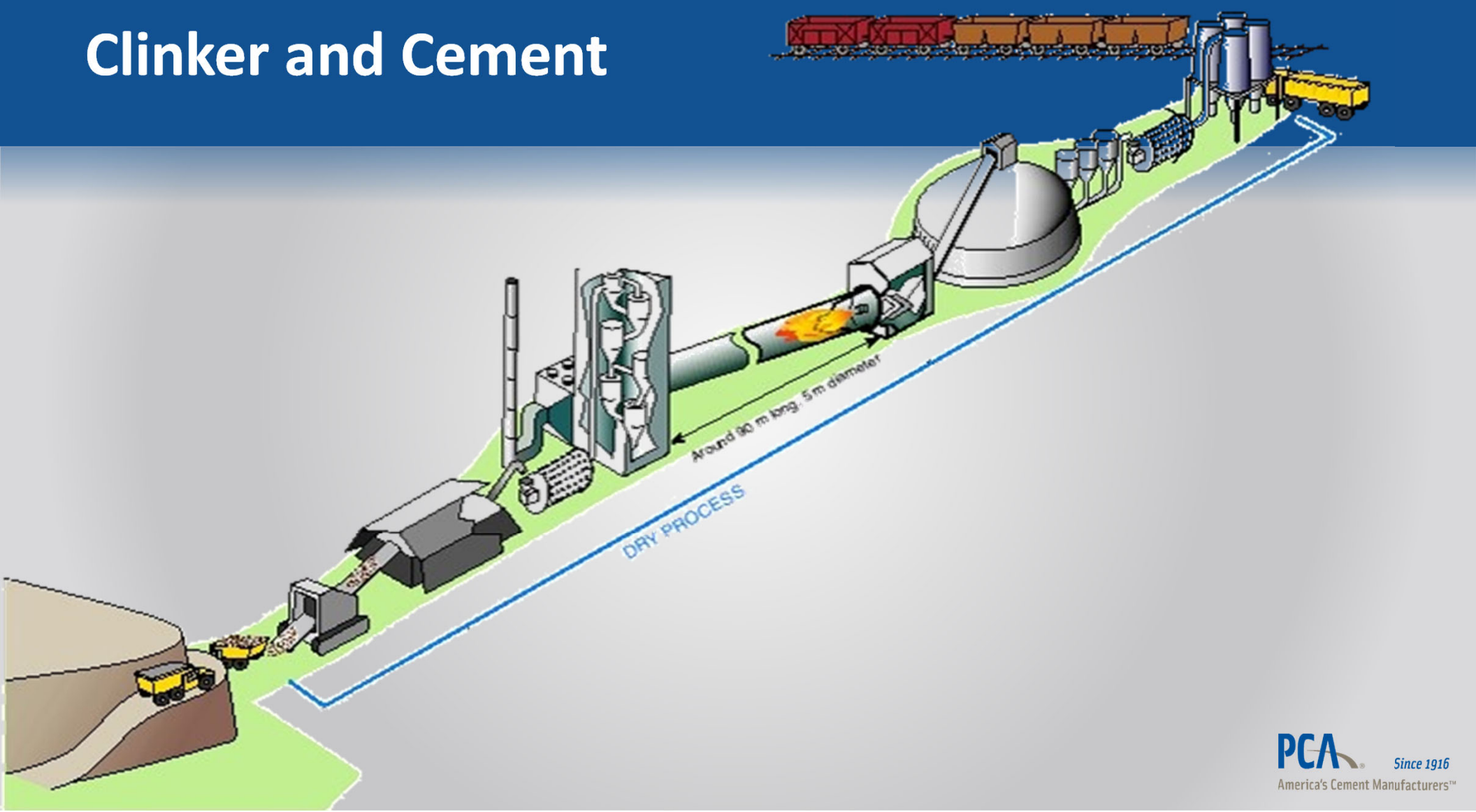
Clinker and Cement



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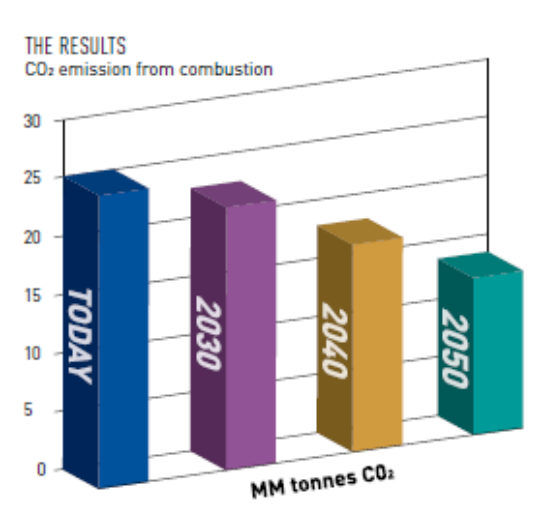
OPTIMIZING CLINKER PRODUCTION



Near- and mid-term

- Efficiency improvements – some opportunities remain
- Increased use of decarbonated/pre-calcined raw feed materials
- Reduced reliance on fossil fuels (esp. coal and petcoke)

Mid- to long-term

- Transformative fuels and technologies: H_2, plasma heating, oxyfuel/oxy-calcination, electric calcination…
- CCUS: solvents, sorbents, membranes, algae…
- **High-risk, high-reward R&D required**

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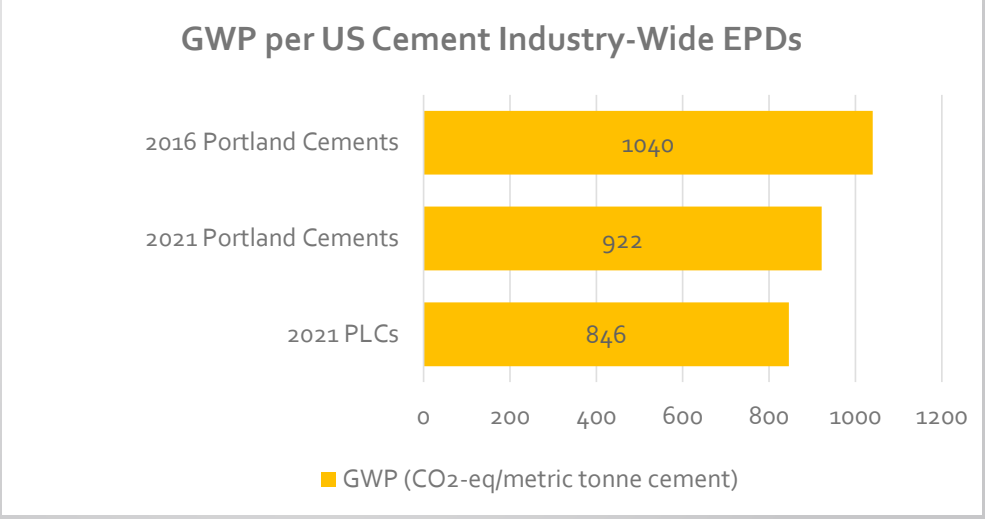
OPTIMIZING CEMENTS

- Clinker-to-cement ratio (target 75% by 2050, not including replacement with SCMs)
- **Increased acceptance/adoption of PLCs (Type IL) and other blended cements (Types IP, IS, and IT).**
- Zero emissions manufacturing & transportation (focus on fuels, CCUS, decarbonated raw materials)
- New cements



PCA'S ROADMAP – ONE YEAR PROGRESS REPORT

CLINKER
Key chemically reactive ingredient

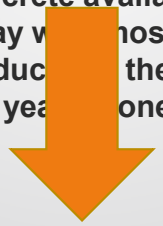
- CCUS Studies
- Input/Review of DoE Decarbonization Roadmap and Carbon Capture Cost Analysis
- PCA and PCA Member company Energy Star Awards
- **Continuing energy efficiency improvements**

CEMENT
The binder

- **More than 20% of all cements consumed in the U.S. are now lower carbon cements including portland-limestone cements and other blended cements, up from less than 5% just two years ago**

CONCRETE
Critically useful material to society

- GSA Low-Embodied Carbon Concrete specification
- **40,000 Type III EPDs for Ready Mixed Concrete available today w[illegible]ost produc[illegible] the last two yea[illegible]one**



February 2023 – about 77,000 concrete EPDs in US and Canada and 80,000 globally

CONSTRUCTION
Service life / use phase impacts

- BuildingGreen.com "The Contractor's Commitment"

CARBONATION
Concrete is a CO_2 sink

- IPCC Recognition
- NIST Low Carbon Cements and Concretes Consortium
- **Preliminary results from MIT show historical carbon uptake of US building sector is as large as 4 Mt CO_2 per year**

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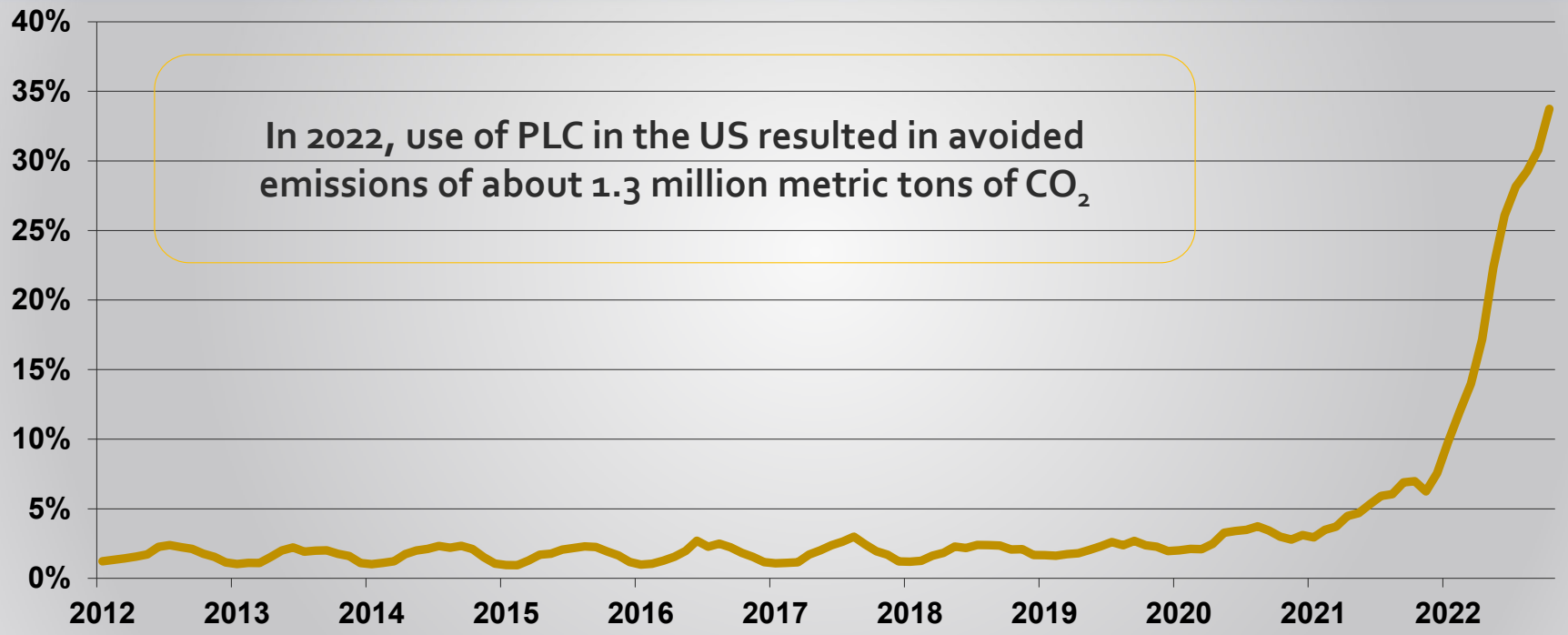
BLENDED CEMENT AS A SHARE OF TOTAL CEMENT - US



Source: USGS

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SUMMARY

We've begun to make progress, but to achieve carbon neutrality for cement and concrete:

- Transformative technologies at massive scale are needed – particularly to address clinker-related emissions.
- Government engagement (regulations, investments in R&D) will be critical.
- Inertia will take us somewhere, but not where we need to go. Purposeful action is required by many stakeholders at every step of the life cycle.

Thank you!

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February 27, 2023 I SCIENCE Workshop