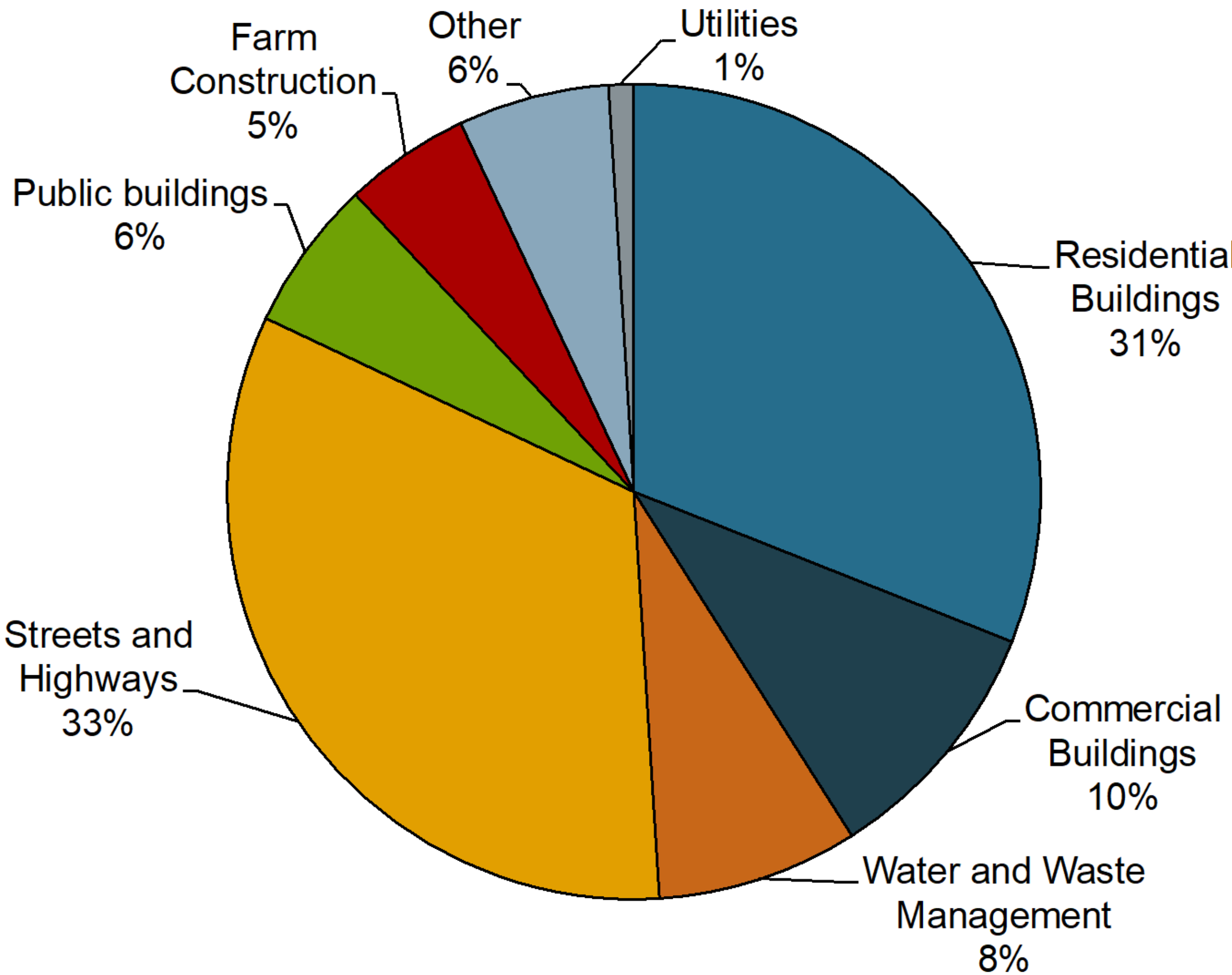
Study of Barriers to Cement Sector Net-Zero Emissions Strategy to Support SB 596 Implementation

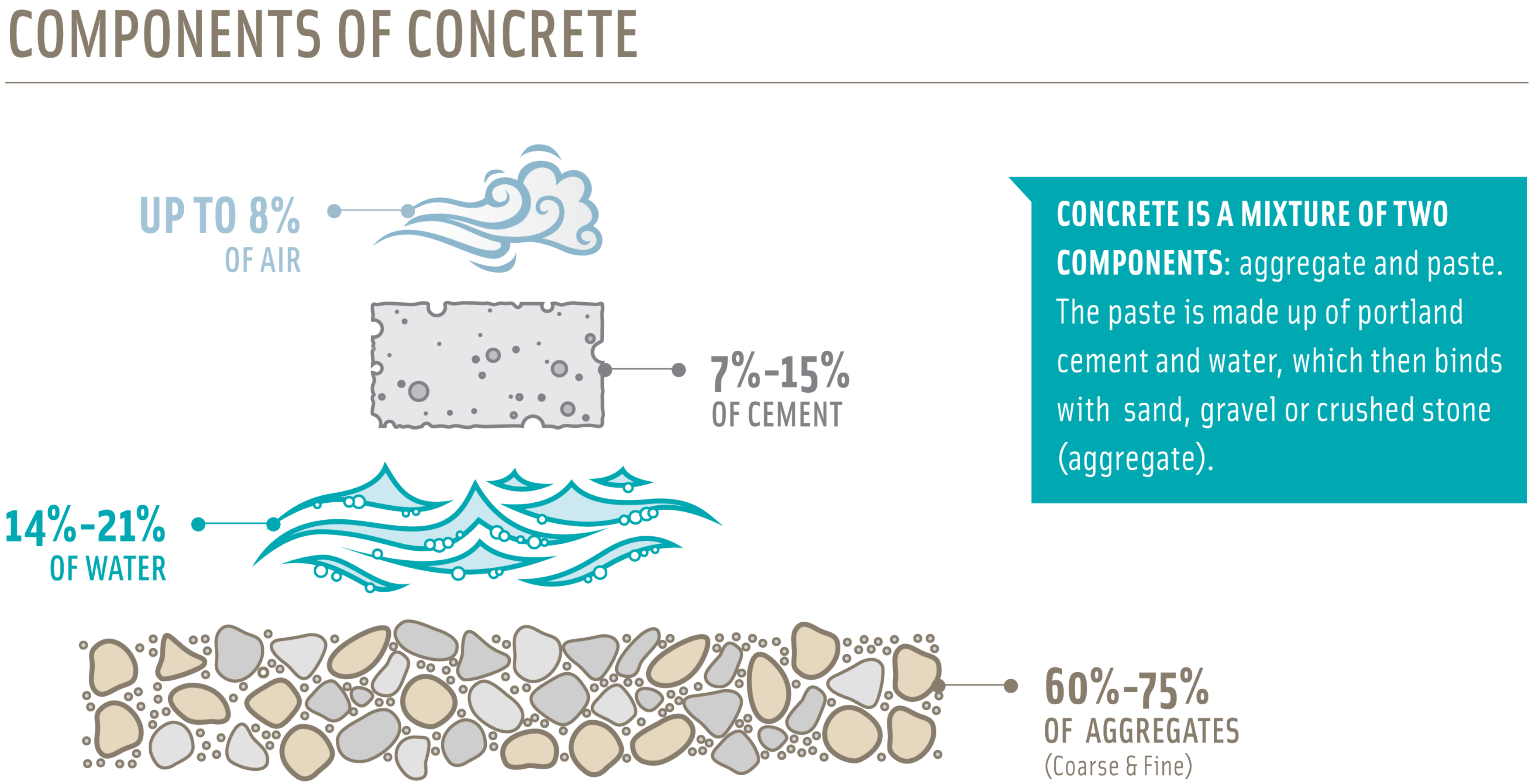
PI: Sabbie Miller
Graduate student researchers: Alyson Kim, Pablo Busch
University of California, Davis

Consumption



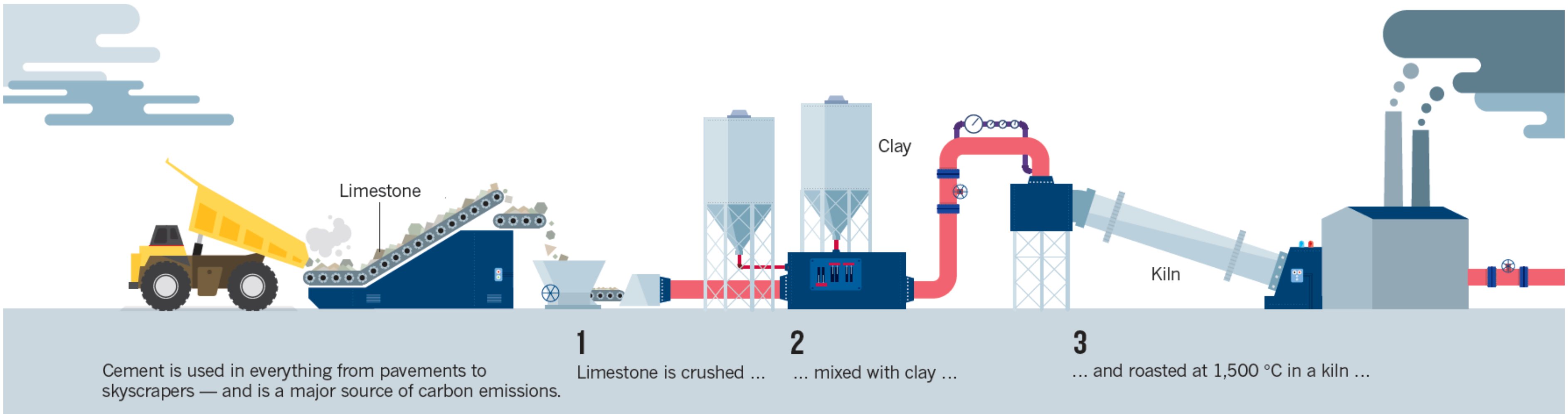
(Kapur, 2008)

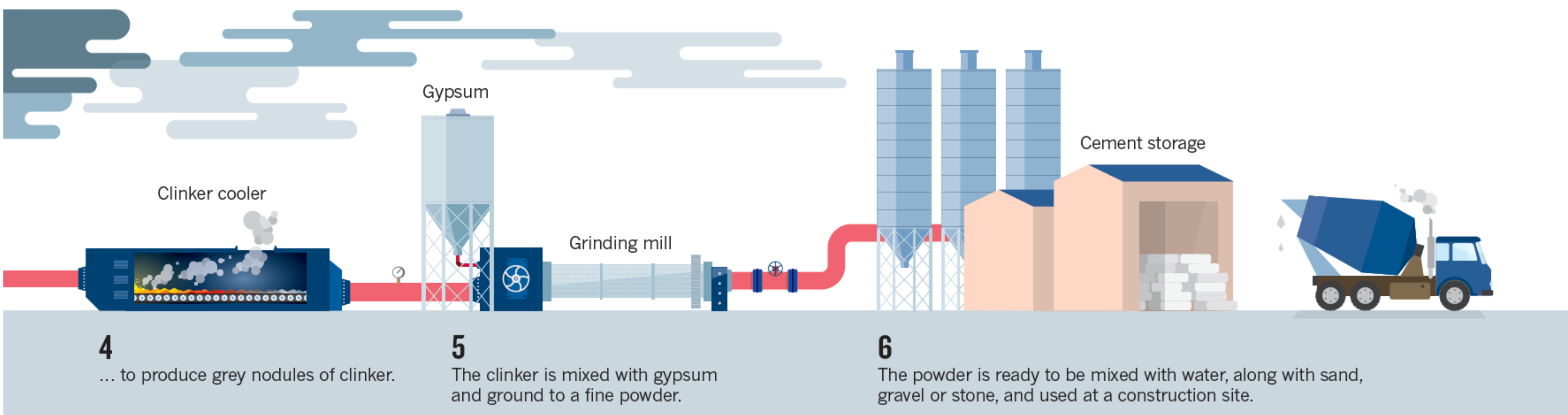
Cement and concrete



(PCA 2017)

Cradle-to-gate material manufacture





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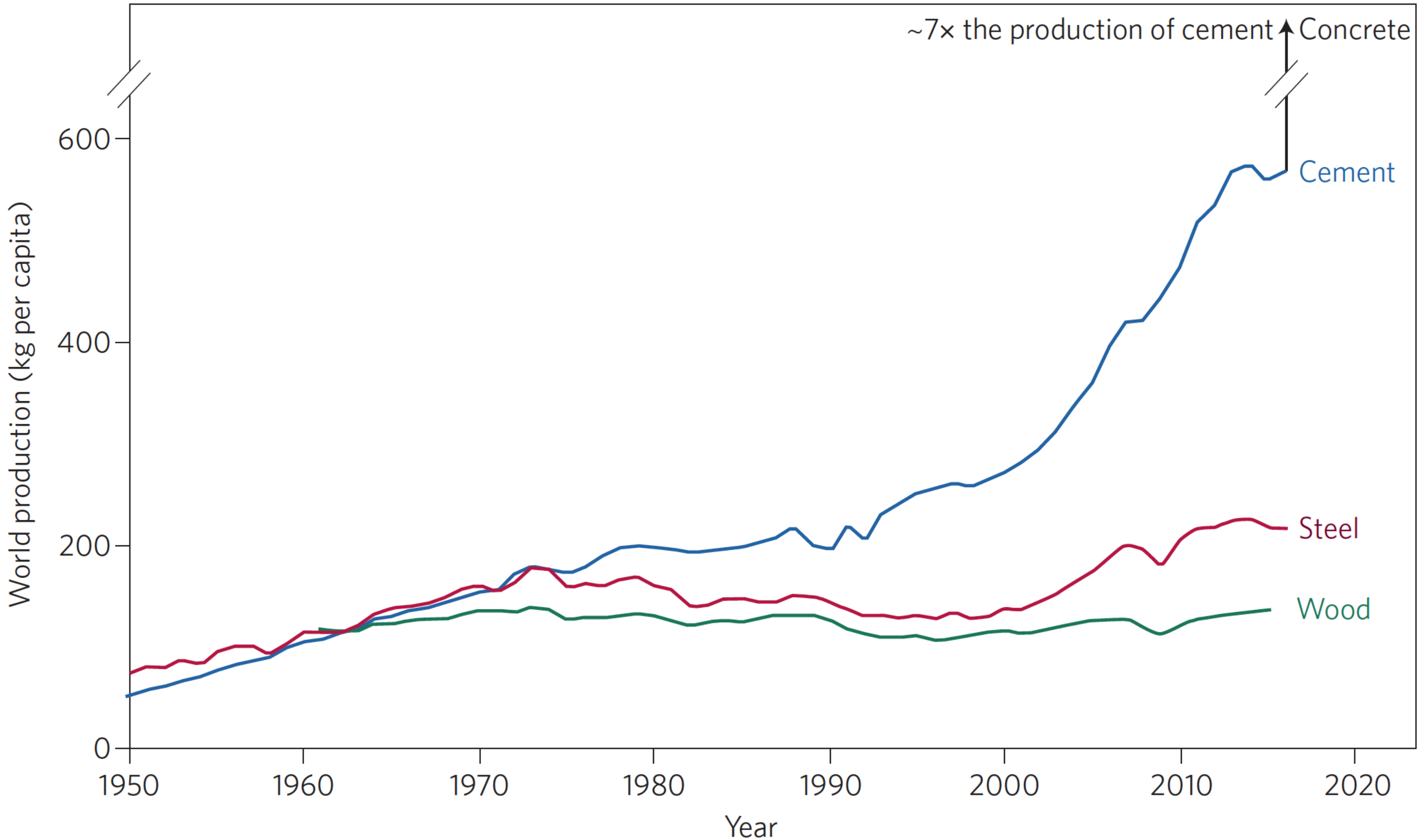
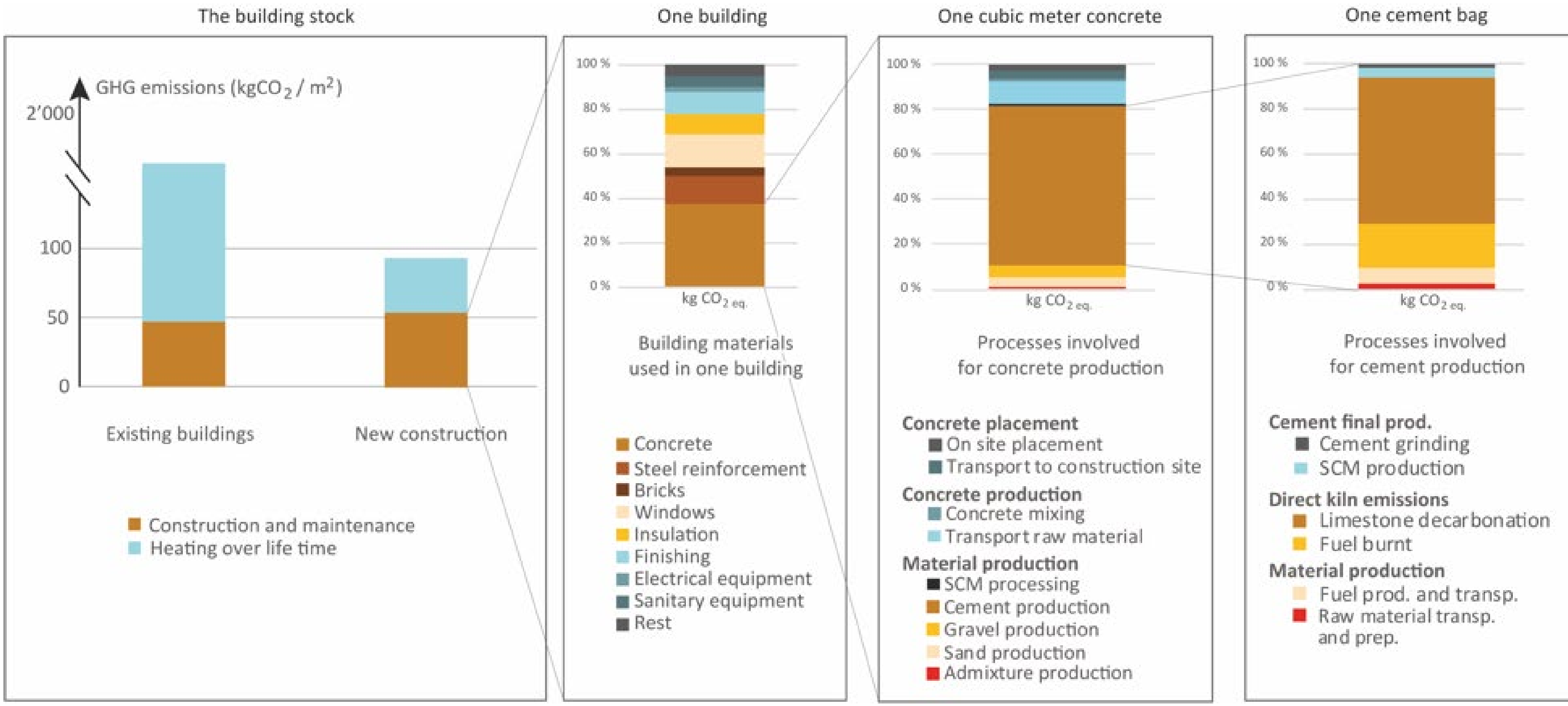
(Amato, 2013)

Consumption



(Monteiro, 2017)

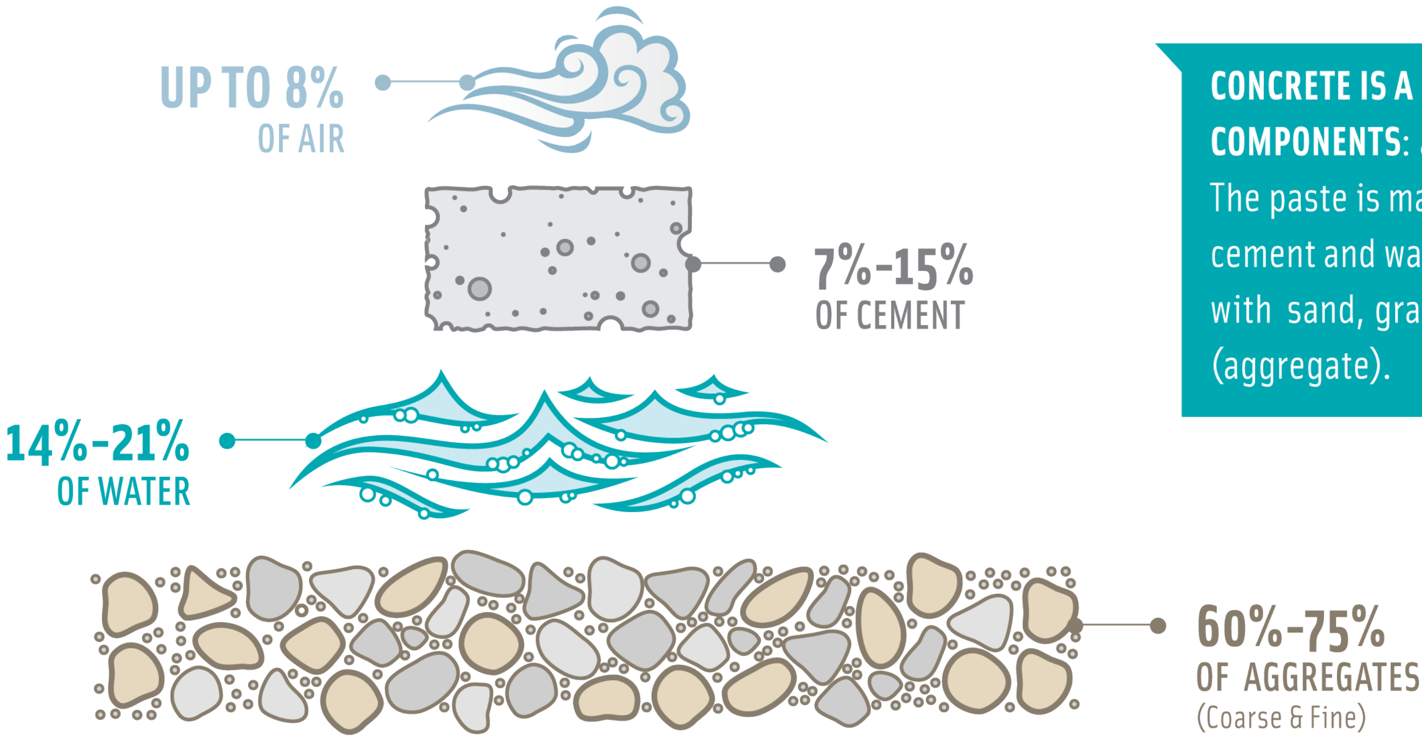
Relative contributions to GHG emissions from cement



(Habert 2020)

Cement and concrete

COMPONENTS OF 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).

(PCA 2017)

Production

(data based on data from 2015)

Methodology

Evaluate technical benefits and limitations to GHG emissions mitigation methods

(Here, work focuses on 7 key categories of technical measures:

(i) Fuel switching for cement kiln direct combustion and electricity generation

(ii) Carbon capture and storage (CCS) – capturing gas at cement kilns

(iii) Increased use of supplementary cementitious materials (SCMs) at concrete plants

(iv) Increased use of blended cements such as Portland limestone cement

(v) Use of alternative clinkers

(vi) Use of alkali-activated materials (AAMs)

(vii) Energy efficiency and waste heat recovery at cement plants)

Examine key barriers to the implementation of these seven key technology groups

Synthesize policy mechanisms that could support implementation of measures that will lead to emissions goals

Technology solutions – “menu” of strategies

A synopsis of initial results from prior work:

Mitigation Strategy	% Reduction in GHG emissions (kg CO_2-eq / kg cement)
Changing electricity source	5%
Changing kiln fuel source	16-26%
Increased use of supplementary cementitious materials (SCMs)	15-35%
Alternative clinkers	24-140%
Alkali-activated materials (AAMs)	0-89%
Carbon capture and storage (CCS)	66-74%

(Findings from Kim et al., In preparation; note: assumptions and inputs may vary for California-specific work)

Progress to date

Stages of work

Scoping – completed
Research – underway
Report preparation – underway

Report draft sections completed

Introduction
Methods
Glossary

Report draft sections underway (to be completed before May 2023)

(1) Identifies and assess key barriers for each identified technical measure,
(2) Identifies methodologies to understand the impacts,
(3) Assesses the California cement and concrete markets,
(4) Assesses areas for research, development, and demonstration, and (5)
(5) Recommends California-specific measures to best support implementation of SB 596

Intervention point, time horizon, and geographic applicability for each technology

Mitigation Strategy	Intervention Point						Time Horizon for Implementation			Geographic Applicability Restrictions	
	Clinker	Cement	Concrete	Designer	Use	End-of-Life	short	mid	long	Potentially more	Potentially less
Fuel Switching in Kilns	x						x			x	
Carbon Capture, Utilization & Storage	x	x	x					x	x		x
Supplementary Cementitious Materials (SCM) at concrete plant			x				x			x	
Supplemental Cementitious Materials (SCM) at cement plant	x	x					x				
Alternative Cements		x	x					x	x	x	
Alkali-Activated Materials		x	x						x	x	
Energy Efficiency	x	x					x				x

Still considering what a material must do

Must still be a viable material for the market

"We've made your environmental report greener. It now uses 50% less paper."

Peter Hess

Policy levers – some key mechanisms considered

Potential Mechanisms	
Public procurement	Education and training program
Carbon pricing	Communication campaign
Tax credits	Transparency-data reporting and sharing
Financial incentives	Roadmap planning
Eliminate subsidies on fossil fuel	Adopt life-cycle mindset
Financial support for R&D and infrastructure	Foster public-private partnerships
Accelerate permitting process and technical assistance	Identification of geographical clusters for CCUS
Review and update existing regulations and codes	Develop or refine models
Develop protocols/guidelines for best practices	Run accelerator for development of new technologies
Develop rating/certification systems for low-carbon cement	Conduct pilot projects at scale

Acknowledgments

PI: Prof. Sabbie Miller

Graduate student researchers: Pablo Busch & Alyson Kim

Research contact: sabmil@ucdavis.edu

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